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THE SIGNIFICANCE OF CERTAIN CHANGES IN THE TEMPORAL REGION OF THE PRIMITIVE REPTILIA.

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CERTAIN "mutations" or lines of definite evolution seem at the present time to be well established in the various mammalian phyla. Typical of such lines are the changes involved in the development of the Perissodactyla and Artiodactyla from the pentadactyl forms of the Eocene; the development of the complicated carnivorous and herbivorous molar teeth from the simple tritubercular type and the gradual assumption of the molariform condition by the premolars of the herbivorous forms. Around such persistent lines of development have gathered the minor changes or "variations" determining the various genera and species.

As yet there has been no recognition of such a line of definite evolution among the Reptilia, but it is the belief of the author that such a line can be demonstrated. The series of changes alluded to are those involved in the development of the temporal region of certain of the Permian Reptilia. Closely connected with this series are other changes, such as the gradual assumption of the tuberculate condition of the teeth and the introduction among the tarsal bones of a calcaneum.

The Pareiasauria Seeley (Cotylosauria Cope) are undoubtedly the most ancient of known Reptilia. The resemblance of these forms to the Amphibia demand that they be removed from union with the remaining Permian Reptilia in the group Anomodontia and considered as the ancestral form from which the Proganosauria have been derived, not the reverse, as suggested by Haeckel. The most perfect form of this group known is *Pareiasaurus bombidens* O. The cranial characters in which this form resembles the Labyrinthodonta are thus summed up by Seeley (1). "The head shows five Labyrinthodont characters: (1) the form; (2) the sculpture of the cranial bones; (3) the arrangement of the bones that cover the head; (4) the presence of mucous canals between the orbits and nares; (5) the absence of the lachrymal bone from the anterior corner of the orbit of the eye." To this evidence may be added the presence of a cleithrum, figured by Seeley as an epiclavicle (2). The presence of a cleithrum in the Pareiasauria is confirmed by the evidence of an isolated scapula belonging to this group from the Texas Permian, now in the museum of the University of Chicago. To the upper end of this scapula is attached the distal end of an element that can only be a cleithrum.

From the Pareiasauria arose the Proganosauria by a series of changes involving the appearance of two fossæ in the temporal region. The first appeared between the squamosal-parietal and the prosquamosal-postorbital, the second and lower between the prosquamosal-postorbital and the quadratojugal-jugal. This resulted in the formation of two temporal arches, an upper, the postorbital, and a lower, the jugal.

In describing the quadrate of Pareiasaurus, Seeley says (2), page 325, "the quadrate bones are vertical, compressed, oblique plates, which extend outward and backward. They are five and one-half inches high, and in contact throughout with the external temporal shield." A figure of a quadrate is given by the same author (3), which he refers "to Pareiasaurus or a near ally"; this figure shows the characters mentioned above. The American forms of this group show the same form of elongated quadrate.

In Paleohatteria, one of the earliest of the Proganosauria, we find the same elongate quadrate. Changes in other regions of

the body, the tarsus, abdominal ossicles, and distal end of the humerus, gave rise to the Rhyncocephalia. The temporal regions of Proganosauria and Rhyncocephalia are very similar, the only difference being that in the first order the squamosal and prosquamosal are separate, while in *Sphenodon*, a typical rhyncocephalian, they are united. The condition of this region in the two forms is indicated in Fig. 1.

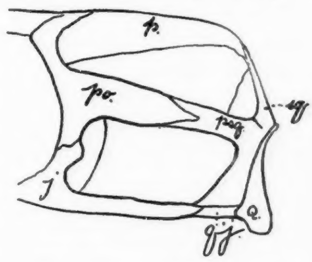


Fig. 1.—Temporal Region of the Skull of Sphenodon.

j, jugal; *p*, parietal; *po*, postorbital; *psq*, prosquamosal; *Q*, quadrate; *qj*, quadratojugal; *sq*, squamosal.

Before the development of the Rhyncocephalia, however, there appeared among the early Permian reptiles forms which exhibited the first steps in one of the most profound mutations of the reptilian line. These forms show a flattened form of quadrate instead of the elongated form of previous orders. It has been shown by Baur and the author (4) that the Pelycosauria of Cope are very similar in structure to the Rhyncocephalia, differing chiefly in the flattened quadrate. The difference in the temporal region of these forms from that of the Rhyncocephalia can be readily seen by comparing Fig. 2 with Fig. 1.

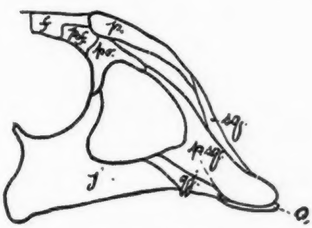


Fig. 2.—Temporal Region of the Skull of Dimetrodon.

f, frontal; *pof*, postfrontal. Other lettering same as in Fig. 1.

In the paper just cited, page 113, the authors stated that they considered the Pelycosauria "a specialized side branch of a line leading from the Proganosauria to the Rhyncocephalia." The author is now inclined to attach much greater importance to the appearance of the flattened quadrate at this point. The Pelycosauria and many of the Permian forms from South Africa and Russia all show this character of a depressed quadrate more or less completely surrounded by the supporting

bones. They seem to form a definite group, with this feature as the common point in their structure. The quadrate is not equally depressed in all forms, nor equally surrounded by the bones of the temporal region. Thus the ancestors of the Pelycosauria were in all probability forms lacking the elongate neural spines characteristic of this group, with the quadrate distinct from the surrounding elements and not so much depressed. These forms are as yet unknown. The Pelycosauria are no longer considered as a side branch of the main reptilian line, but as one member or branch of an equally divided line leading from the Proganosauria.

From this point onward the Reptilia are divided into two groups, one with an elongate quadrate which includes all modern and most extinct Reptilia, and one with a depressed quadrate reaching its highest development in the Permian, and in all probability losing its identity by almost imperceptible stages in the direct ancestors of the Mammalia.

Haeckel, in his *Systematische Phylogenie* (Vertebrata), page 299, has grouped the Permian forms under two orders, the Theriodontia (*Mastocephale theromoren*) and the Anomodontia (*Chelycephale theromoren*). In the first order he places the suborders Pareiasauria, Pelycosauria, and Palatosauria; in second the Dicynodontia and Udenodontia. If it be true that the Pareiasauria are a distinct order they must be dropped from this group. Then the remaining suborders, as defined by Haeckel, comprise the forms possessed of the depressed quadrate. It has been shown by Baur and Case (4) that the group Theromora does not exist, and it is now suggested that the forms with the depressed quadrate be referred to as the mastocephalous Reptilia, because of their evident culmination in the Mammalia, while the remaining Reptilia may be described as saurocephalous. In no known form, so far as I am aware, is there a tendency for a member of one of these groups to assume the form and condition of the quadrate characteristic of the other.

Leaving out of consideration the aberrant Dicynodontia and Udenodontia, a steady progress can be traced from the primitive pelycosaurian forms to the mammal-like forms. The quadrate of the early forms, while flattened and covered to a

considerable extent by the squamosal and prosquamosal bones, still shows to a considerable extent on the side of the skull; in the succeeding forms the quadrate is more and more reduced and the squamosal approaches more and more to an articulation with the lower jaw. Accompanying these changes are certain others, indicated below:

Pelycosauria: Quadrate depressed, appearing on side of skull. Teeth simple. Two well-developed arches.

Procolophonia: Quadrate depressed, nearly covered by the greatly enlarged quadratojugal (?). Teeth simple, reduced in number. Arches approximated only, a small foramen existing between the upper and lower.

Cynodontia: Quadrate covered by supporting bones. Teeth showing small lateral tubercles. Arches more closely approximated than in Procolophonia.

Lycosauria: Quadrate small, covered by supporting bones. Skull depressed. Teeth with well-developed tubercles. Arches united.

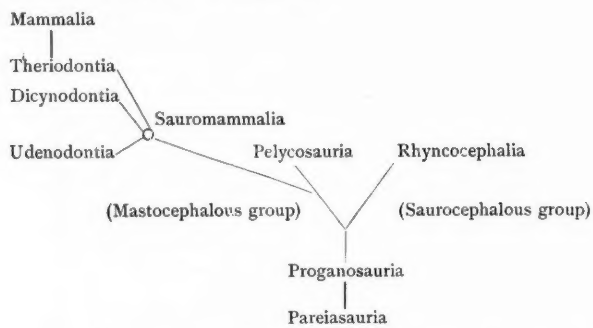
Gomphodontia: Quadrate very small, and inclosed in squamosal. Teeth tuberculate. Palate mammalian. Arches united.

The author was at one time undecided as to the nature of the arch in the Lycosauria and Cynodontia; in connection with Baur he said (4) that the mode of formation of the arch was uncertain. A specimen of *Cynognathus crateronotus*, figured by Seeley, shows an opening between the upper and lower arches which was uncertain in origin, there being some reason to suppose it to be the result of an injury to the specimen, but a study of the figure of Procolophon, given by Seeley, shows the same condition. The enormous quadratojugal (called squamosal by Leydekker) joins the jugal in front, which in turn joins a slender element by its anterior superior corner; this element runs backward, forming the lower and back portion of the orbit, and is undoubtedly the postorbital. Behind this element is another bone, the squamosal, or squamosal + prosquamosal, which rests upon the quadratojugal below; between all these elements is a small cavity, exactly as in Cynognathus. It is hardly probable that a break would occur in the same place in the two specimens, and so they are considered as showing the final stages of the union of the two arches to form the mam-

malian zygoma. This fact is further borne out by the very evident union of the two arches in Placodus and Cyamodus.

If this is true, the Theriodonta (Cynodonta + Lycosauria + Gomphodonta) cannot be the ancestors of the Squamata and Sauropterygia, as suggested by Cope (5). In these forms the history of the arches is very different. The Squamata possess only the superior temporal arch.

It is readily seen that the scheme here offered differs very little from that suggested by Baur in 1887 (6). The chief differences are the placing of the Pareiasauria as the most primitive group of the Reptilia, and the position of the mastocephalous Reptilia in opposition to all the remaining Reptilia, the changes in the quadrate region being the determinate feature in both groups. The following diagram will serve to make clear the ideas here expressed.



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MANASSEH CUTLER.

JAMES ELLIS HUMPHREY.

A MAN who clearly deserves a distinguished place among American pioneers in science is the subject of this sketch. Without advantages of birth, and through life dependent on the meager stipend of a New England country minister, he yet contributed much useful work to the development of science and to the extension of civilization in the United States. Two volumes of extracts from his letters and journals, of the greatest interest and value, were published by some of his descendants at Cincinnati in 1888. These give a striking impression of his progressive spirit and tireless activity, and furnish the chief available facts concerning his life.

Manasseh Cutler was born May 3, 1742, the son of a farmer of Killingly, Conn. His home was evidently one in which the Puritan love of learning prevailed, for he was graduated at Yale in 1765. He then obtained a position as a teacher in Dedham, Mass., a somewhat unusual thing at the time when the towns about Boston were accustomed to look to Harvard for their teachers. Here he became acquainted with Miss Mary Balch, daughter of Rev. Thomas Balch, the minister at Dedham, and she became his wife in 1767. In that year he went to Edgartown, on Marthas Vineyard, to take charge of and close up the business of a relative of his wife, just deceased. While there he was admitted to the bar, having devoted his time since his graduation to reading law. But his first experiences in legal practice gave him a distaste for it, and he determined to enter the ministry.

Accordingly, he returned to Dedham and began a regular course of study with his father-in-law. The glimpses of his experiences and deliberations while preaching as a candidate in several Massachusetts parishes, afforded by his journal, show the shrewd and cautious man, with keen zest for amusing situations and with clear understanding of and sympathy with human

nature beneath the preacher's coat. Finally, in 1771, he accepted a call to Ipswich Hamlet, on Cape Ann, which was set off in 1793 as the new town of Hamilton. Here he remained fifty-two years, until his death, increasingly loved and respected, and the most influential man of the region. In his time the nearest place of importance was Salem, then at the height of her prosperity as a great shipping port. Mr. Cutler soon acquired a reputation there as a teacher, and received important additions to his slender salary for fitting the sons of many distinguished families for college, as well as for training in the theory of navigation many a young man who became a famous shipmaster in the East India trade. He never received from his parish more than four hundred and fifty dollars a year — then relatively a much larger sum than now, it is true.

During the Revolution the great need of army surgeons at the front called away the village doctor from Ipswich Hamlet, and the minister took it upon himself to study medicine, that his people might not be without help in sickness. At another time he served several months as a regimental chaplain in the Continental Army. It seems very likely that his medical studies first developed his interest in natural science; for we know that this branch of knowledge played no important part in college curricula in his day, and the first evidences of his attention to it date from this time. His interest in botany seems always to have predominated, and his chief publication was upon this subject. Yet he corresponded with many of the most distinguished scientific men of his time in both Europe and America on a great variety of the subjects then most discussed. Among these were the aurora borealis and other meteorological matters, physical problems, the habits and migrations of animals, as well as the plants of his own and other regions.

In June, 1780, he records having read Hales' *Vegetable Staticks* and his wish to follow out some lines of experimentation suggested to him by the reading. He evidently caught from it the inductive spirit, of which Hales' work was the first fruit in its field of research. The difficulties under which he labored may be understood from a letter written at this time to his friend, Professor Williams, of Harvard. He says: "I have

thought of several experiments which I fancy may be well worth making, but cannot well proceed without a barometer. I have a prospect of getting a tube soon, which you have been so kind as to offer to fill with the mercury. The scale I can get made in Salem if I could procure a barometer for a pattern; but there is none in that town. . . . If there is any gentleman of your acquaintance in Boston who has a barometer and makes little use of it, and would be so kind as to favor me with it until I can get one completed, I shall consider it as a very particular favor." A few months later he wrote to the Corporation of Harvard College for permission to take from the college library certain books which he had failed to procure in Europe, and which he had needed for the study of plants.

On January 31, 1781, the American Academy of Arts and Sciences held its first meeting for the transaction of business. It then elected officers and chose some new members, among them Mr. Cutler. Two years later he was made a member of the Committee on Communications in Natural Philosophy and Natural History, his associates being Theophilus Parsons and Gen. Benjamin Lincoln. He was one of the first party which visited the White Mountains for scientific observations, in July, 1784, and especially studied the plants of the region. Twenty years later he repeated the journey. In 1785 appeared the first volume of the *Memoirs of the American Academy*, which contains his chief published writing, "An Account of Some of the Vegetable Productions Naturally Growing in this Part of America, Botanically Arranged." This was the first connected account of any part of the flora of any American region by a native writer. The plants were arranged, of course, according to the Linnæan system, and there were many discriminating notes concerning the uses and peculiarities of various species. In the same year he was elected a member of the American Philosophical Society of Philadelphia. In the third volume of the *Memoirs of the American Academy* is a figure with brief "Remarks on a Vegetable and Animal Insect." This is an account of the larva of a stag beetle attacked by the *Clavaria militaris* of Linnæus, a fungus now known as *Cordyceps militaris*. It shows a clear understanding of the relations between

host and parasite quite free from that air of marvelousness which still pervades popular accounts of similar phenomena.

In July, 1787, Cutler went to New York to visit the expiring Continental Congress, and succeeded, largely by his personal influence, in securing favorable action on the proposed grant of land beyond the Alleghanies for settlement to a company in which he was interested. The evidence seems conclusive that his hand drafted at least that clause of the "Ordinance of 1787," for the government of the Northwest Territory, which forever excluded slavery from its limits, and which has been regarded as, in its effects, the most far-reaching single piece of legislation in the history of the country. Thence he went on to Philadelphia, where the constitutional convention was in session. While there he visited Dr. Franklin, then eighty-one years old. His embarrassment on meeting so famous a man and the way in which he was put at ease by Franklin's simplicity and cordiality, as well as the ill behavior of the great man's grandchildren, are all delightfully described in his journals. His accounts of this visit and of that to Carpenter's Hall mention especially the botanical books he saw. One morning he went with friends out to see Bartram's garden, on the Schuylkill, already falling into neglect. On the return journey to his home he stopped at Bordentown, N. J., to call on Michaux at his nursery there. He failed to find the owner, but saw his garden and recorded his impressions thus: "What could induce Mechard to fix down in this awful, gloomy, lonely, miserable spot is beyond my power to conceive. I was never more disappointed, and regretted the pains I had taken to see the ill taste and judgment of this botanical Frenchman."

In December of the same year a party left Mr. Cutler's house in Ipswich Hamlet with an ox-wagon bound for "Marietta on the Muskingum,"—the first settlers of the Northwest Territory. In the party were two of Mr. Cutler's sons. They arrived at their destination in the following April, and a few months later were visited by their father, who may fairly be called the father of the settlement. He had driven across the country in a chaise from his home, and returned in the same way after a stay of a few months. He prepared the charter of

Marietta College, and, while on the ground, made the first studies of the earthworks of the Ohio valley, computing their minimum age from the trees and remains of trees found growing on them. Some partly decayed stumps were found, between eight and nine feet across, on which it was impossible to count the annual rings. But he estimated a tulip tree, five feet and eleven inches in diameter within the bark, to be from four hundred and forty-one to four hundred and forty-five years old.

In 1789 his *alma mater* conferred on Mr. Cutler the degree of LL.D. Besides the societies already mentioned, he became a member of the Massachusetts Historical Society, the American Antiquarian Society, the New England Linnæan Society, and the Massachusetts Society for Promoting Agriculture; and he was made an honorary member of the Massachusetts Medical Society for his attainments in the healing art. He served as a member of Congress during two terms, from 1801 to 1805, as an uncompromising Federalist. His journals give a vivid idea of the intensity of political feeling in this first period of Democratic supremacy.

He had evidently planned an extended botanical work, and for many years collected notes and drawings with this in mind. They finally filled more than a dozen large volumes, which suffered much injury from a slight fire in his study during his temporary absence from the room. This occurred in the latter part of his life, and seems to have disheartened him. A part of these volumes were at one time in the possession of the late Prof. Edward Tuckerman, of Amherst College, who has said that the publication of the results of his studies would have given Dr. Cutler high rank as a botanist. In these manuscript volumes he recorded conclusions which were only given to the world when again reached by Bigelow, Nuttall, Gray, and others. For example, he recognized that the hickories are generically distinct from the walnuts, and indicated many new species first published by the authors already named. He was a great lover of plants from every point of view. His large garden contained a great variety, especially of trees and shrubs. He is said to have introduced into eastern Massachusetts the

buckthorn from England, the pawpaw, the persimmon, the tulip tree, the trumpet vine, and many more from farther west and south.

Dr. Cutler died July 28, 1823, and lies buried beneath a marble slab, on which, without fulsomeness of eulogy, a long epitaph recounts his many virtues and accomplishments. The writer made in 1896 a pious pilgrimage to the scene of his labors, still a sleepy little village, as he left it. There, all within a stone's throw, may still be seen the house where he lived, now enlarged and transformed, the church where he preached, remodeled since then, but still bare and uninviting, as in his day, and the old cemetery where he rests. Such an occasion makes one realize, as we do far too seldom, how much our modern science owes to men like Dr. Cutler. He has not left a great scientific reputation, it is true, though doubtless he might have done so under less adverse circumstances. But he did what he could. He was a pioneer in a new country, not merely a pioneer in science, but a pioneer for truth and civilization in every form, trying always to push back the limits of the intellectual and physical wildernesses of his time, and to clear the ground, not alone for cities and material gain, but with a view also to the upbuilding of sound learning and the enrichment of the world's knowledge, which material prosperity makes possible and ought to make certain.

THE WINGS OF INSECTS.

J. H. COMSTOCK AND J. G. NEEDHAM.

CHAPTER II.

The Venation of a Typical Insect Wing.

THERE are certain features of the venation of the wings of insects which occur in the more generalized forms of so large a proportion of the orders of this class that we are warranted in regarding them as typical of winged insects as a whole, and we are able to present a hypothetical type to which the wings of all orders may be referred.

This of course implies, what we believe to be the case, that all of the orders of winged insects have descended from a common winged ancestor. For it is not probable that had wings arisen more than once in this class that they should agree closely in their structural characteristics.

The recognition of the features of the wing venation that are common to the various orders of insects has been a matter of slow growth. Most writers on the subject have only attempted to work out the homologies of the principal veins within the limits of a single order; and thus have arisen the various systems of nomenclature of the wing-veins, which have done much to delay an appreciation of the uniformity of structure which really exists.

We will not take the space to trace out in detail the development of the idea that a uniform nomenclature of the wing-veins, based on homologies and, therefore, applicable to all orders, is possible. In 1870 Hagen attacked the problem in a paper, entitled "Ueber rationelle Benennung des Geäders in den Flügeln der Insekten."[1]. But this essay apparently had little influence beyond calling attention to the importance of the subject. It was not till the appearance of the classic contribu-

[1] *Stettiner Entomologische Zeitung*, Bd. xxxi, pp. 316–320.

tion of Redtenbacher[1] that any great progress was made. This paper, with its numerous illustrations drawn from nearly all orders of winged insects, is really the starting point in the actual solution of the problem.

Unfortunately, however, Redtenbacher was misled by the erroneous theory of alternating convex and concave veins elaborated by Adolph.[2] The result was that, although Redtenbacher recognized the homologies of the main stems of the principal veins, he, in his efforts to apply this theory, was led into many serious errors.

Then Spuler[3] followed, and, basing his conclusions on a study of the tracheæ that precede the wing-veins, worked out the type of the lepidopterous wings. Unfortunately, Spuler overlooked the trachea that precedes the first of the principal veins, and began his numbering with the second principal vein, which he designated as vein I.

The next step in advance was made by the senior writer of the present series of articles. In a text-book of entomology[4] he worked out the homologies of the wing-veins in the Lepidoptera, Diptera, and Hymenoptera. In the preface of that book he said:

> The principal features of the method of notation of wing-veins, proposed by Josef Redtenbacher, have been adopted. But as the writer's views regarding the structure of the wings of primitive insects are very different from those of Redtenbacher, the nomenclature proposed in this book is to a great extent original. The chief point of difference arises from the belief by the present writer that veins IV and VI do not exist in the Lepidoptera, Diptera, and Hymenoptera; and that, in those orders where they do exist, they are secondary developments.

But again, unfortunately, the work was not carried far enough. While the non-existence of the concave veins IV

[1] Josef Redtenbacher, Vergleichende Studien über das Flügelgeäder der Insecten. *Ann. des. k. k. naturhist. Hofmuseums*, Bd. i, 1886, pp. 153–232.

[2] G. Ernst Adolph, Ueber Insectenflügel, 1879.

[3] A Spuler, Zur Phylogenie und Ontogenie des Flügelgeäders der Schmetterlinge. *Zeit. f. wiss. Zool.*, Bd. liii, 1892, pp. 597–646.

[4] J. H. and A. B. Comstock, *A Manual for the Study of Insects*. Ithaca, N. Y., 1895.

and VI of the Redtenbacher system was demonstrated for the orders named, no use was made of the wing venation in the other orders of insects; and his lack of definite knowledge on the subject made him willing to admit that these veins might exist as *secondary developments* in those orders with fan-like wings.

At last the time has come when we believe that we understand the homologies of the wing-veins in so large a proportion of the orders of insects that we are able to present a hypothetical type to which the wings of all orders may be referred. And this type includes not only the principal veins, but also the chief branches of these veins.

It should be borne in mind that our main object at this time is merely to trace the homologies of the wing-veins, to the end that a uniform nomenclature for all orders can be adopted, and also to enable us to make intelligent use in taxonomic work of the characters presented by them. We do not presume to say that we have definitely determined the peculiarities of the venation of the wings of the stem form from which winged insects have descended. We feel, however, that we have reached a sufficiently near approximation to this desired end to warrant our conclusions regarding the homologies of the wing-veins, and to enable us to commend a nomenclature for them which we believe can be accepted as final.

In designating the wing-veins they may be either named or numbered. The simplest method is, doubtless, to number them; and had the system which was proposed by Redtenbacher been based on a correct understanding of the primitive type, nothing better could be desired. But it was not; and, as several modifications of the Redtenbacher system are already in use, it seems doubtful if uniformity in numbering them could be soon brought about.

From the great mass of names that had been proposed for the principal wing-veins, Redtenbacher selected a set of terms, to the acceptance of which no objection has been urged. It seems, therefore, that the surest way to bring about uniformity of nomenclature is to give up the attempt to apply a set of numbers to the wing-veins, and to use the names adopted by

Redtenbacher. These names and the abbreviations of them, which we shall use in our text as well as in the figures illustrating it, are as follows:

Costa, *C.*	Media, *M.*
Subcosta, *Sc.*	Cubitus, *Cu.*
Radius, *R.*	Anal veins, *A.*

In designating the branches of the forked veins we have adopted the principle of numbering them proposed by Redtenbacher and combine the numbers with the abbreviations of the names of the veins. Thus, the first branch of radius is designated as *radius-one;* and for this term the abbreviation R_1 is used.

In numbering the branches of the forked veins, *the same number is applied to homologous branches throughout the series of orders.* It is only in this way that the greatest use can be made of the characters presented by the wings in working out the phylogeny of groups.

But, in carrying out this plan, we have found that in certain orders, as, for example, the Neuroptera, there is a marked tendency towards the multiplication of the branches of some of the principal veins. It results from this that we find, in each of these orders, branches that have no true homologues in other orders, although in some cases analogous branches exist. As these supernumerary veins do not concern us while we are discussing the venation of the typical wing, we will postpone the consideration of them.

It frequently happens that the branches of a forked vein are reduced in number by the coalescing of two or more branches. In numbering such a compound branch the coalescence is indicated by the term applied to it. Thus, in very many insects, the second and third branches of radius coalesce throughout their entire extent, forming a single branch; this we designate as *radius-two-plus-three*, writing the term thus, R_{2+3}.

We will postpone for a time the discussion of the nomenclature of the cross-veins and of the cells of the wing, and proceed to a consideration of the hypothetical type to which we have referred.

There can be no doubt that the veins of the fore wings and of the hind wings are homodynamous. Any one that studies the subject much is impressed by this fact. A single diagram will be sufficient, therefore, to represent the venation of both pairs of wings of this type. Fig. 4 is such a diagram.

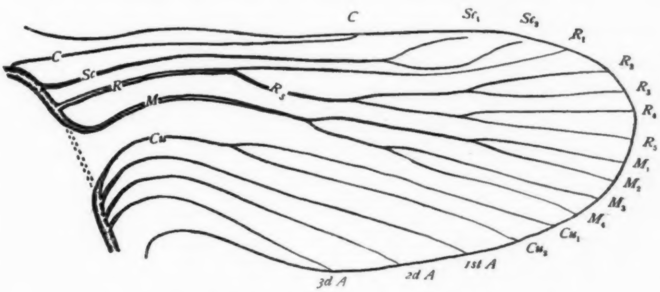

FIG. 4. — Hypothetical tracheation of a wing of the primitive nymph.

As the wing of a nymph is much more instructive than a wing of an adult for the purpose of determining homologies, we represent this ideal wing in that stage of development in which the forming veins appear as light-colored bands and the tracheæ as dark lines. This stage in the wings of an actual nymph is well shown by the half-tone reproductions of photographs of the wings of a nymph of Nemoura, given in Chapter I (Figs. 2, 3).[1] In our hypothetical type we have represented only the tracheæ, which precede the forming veins.

By representing the wing of a nymph we are able to represent the basal connections of the tracheæ that precede the veins, and thus show which are principal veins and which are branches of them. This point has received very careful attention, a large number of nymphs and pupæ, representing nearly all of the orders of insects, having been examined especially for this purpose. Fortunately, this evidence confirms the conclusions reached by various writers who have studied only the wing-veins of the adult, and merely serves to remove any doubt there might have been regarding these conclusions.

Another point which can be brought out in this way is the

[1] *American Naturalist*, January, 1898, vol. xxxii, pp. 46, 47.

distinction between principal veins and cross-veins. For, although in certain highly specialized wings, as, for example, those of the Odonata, every cross-vein is preceded by a trachea, we have found that, as a rule, the secondarily developed cross-veins are not preceded by tracheæ. The figures of Nemoura in Chapter I illustrate this.

In the adult the front, or costal margin, of the wing is usually strengthened by a vein or a vein-like structure; this is designated as the *costa*. A study of immature wings shows that, although the costa usually extends more or less nearly to the apex of the wing, the costal trachea is, as a rule, greatly reduced. This reduction of the costal trachea has led to its being overlooked by previous writers, and to a denial of its existence by Brauer and Redtenbacher.[1] It is true that Brongniart figures what he believed to be the costal trachea in the nymph of a dragon fly;[2] but the structure which he represents is evidently the edge of the wing within the wing sheath of the nymph.

We have succeeded in finding the costal trachea in nearly all of the orders of winged insects, and have found that in widely separated forms, as in many Hemiptera and in the more generalized Hymenoptera, it extends nearly or quite to the apex of the wing. Further details regarding it will be given in the treatment of the separate orders. It is only necessary to state here that we have abundant evidence to support the view that the costa of the primitive insect wing resembled the other wing-veins in being preceded by a trachea, and that the origin and course of this trachea was probably very nearly as represented by *C* in Fig. 4. In the photographs of the wings of a nymph of Nemoura, reproduced in Chapter I, the costal trachea is not evident; but figures will be given of other Plecoptera in which this trachea is as distinct as any and extends to the middle of the wing.

The second of the principal veins of the wing is designated as the *subcosta*. This extends more or less nearly parallel with the costa and but a short distance from it. In those orders

[1] *Zool. Anz.*, Bd. xi, 1888, pp. 443–447.

[2] *Rech. sur les Insectes Fossiles*, Pl. viii, Fig. 1, *a*.

where there are many wing-veins it gives off numerous small branches to the costa; in the orders where there are few wing-veins it appears in the adult to be an unbranched vein. But a study of the subcostal trachea in nymphs and in pupæ shows that it is forked in at least several widely separated orders; we have, therefore, represented it so in our type (Fig. 4, Sc_1 and Sc_2). In adult wings the branches of the subcosta are usually either wanting or appear as cross-veins. In those orders in which the wing is corrugated the subcosta lies at the bottom of a furrow, which stiffens the costal edge of the wing.

The third vein is the *radius*. This is the most prominent vein in the wing; and it is the one which, from the great variety of its modifications, offers more often than any other vein obvious characters of use in taxonomic work. In spite of the wide differences of form of this vein in the different orders, it is now clear to us that these various forms have all been derived from a type which still exists, but slightly modified, in the more generalized Trichoptera, Mecaptera, Diptera, and Lepidoptera, and in certain genera of several other orders. In its typical form this vein is five-branched (Fig. 4, R_1–R_5). The main stem of the vein separates into two divisions; the first of these is simple and is more or less nearly a direct continuation of the main stem — this is *radius-one* (R_1); the second of the principal divisions of radius is typically four-branched, and on account of the frequency of the necessity of making reference to it a special name has been applied to it, the *radial sector* (R_s). The radial sector separates into two divisions (R_{2+3} and R_{4+5}); and each of these again separates into two divisions, the former into *radius-two* (R_2) and *radius-three* (R_3), and the latter into *radius-four* (R_4) and *radius-five* (R_5).

The vein occupying the center of the wing is the *media* (M). In those orders in which it retains most nearly its primitive form it is usually three-branched; but the fact that in the more generalized members of several widely separated orders it is four-branched leads us to believe that it was four-branched in the stem form of winged insects. The branches are designated as *media-one* (M_1), *media-two* (M_2), *media-three* (M_3) and *media-four* (M_4), respectively.

The fifth principal vein is the *cubitus* (*Cu*); this vein separates into two branches, — *cubitus-one* (Cu_1) and *cubitus-two* (Cu_2).

Between the cubitus and the anal margin of the wing there are typically three veins; these are commonly termed the anal veins. We will distinguish them as the *first anal* (*1stA*), the *second anal* (*2dA*), and the *third anal* (*3dA*), respectively, the first anal being the one nearest to the cubitus.

The first anal vein is generally simple; but in those orders where the anal area of the wing is expanded the second and third anal veins become separated into many branches, which form the supports of the fan-like portion of the wing.

Before leaving the discussion of this hypothetical type it seems necessary to say a little regarding the basal connections of the tracheæ that precede the wing-veins. In what appears to us to be the most generalized type, the tracheæ that supply the wing with air arise from two distinct trunks, as shown in Fig. 4. The first of these trunks is a branch of the dorsal longitudinal trachea of the thorax; the second, of the ventral longitudinal trachea. This type exists in all Plecoptera that we have examined and in certain cockroaches; we have not found it elsewhere.

The two groups of wing-tracheæ thus formed may be designated as the *costo-radial group* and the *cubito-anal group*, respectively. When the two groups are distinct, the trachea that precedes the media is a member of the the costo-radial group.

In most insects there has been developed a transverse trachea connecting these two groups of tracheæ; the position of this *transverse basal trachea* of the wing is indicated in the figure by dotted lines. Frequently the transverse basal trachea is indistinguishable from the two main trunks which it connects, the three forming a single, continuous, transverse trachea, from which arise all of the wing tracheæ. All of the stages of this development have been found by us within the Orthoptera.

When a transverse basal trachea is formed, the medial trachea (*i.e.*, the trachea that precedes media) tends to migrate along it towards the cubito-anal group of tracheæ, and often becomes united with that group. This is well shown in certain Orthoptera and in the Hemiptera. In some cases the base of

the radial trachea tends to follow the base of the medial in its migration along the transverse basal trachea towards the cubito-anal group (Acrididæ).

We have found no indication that the formation of a transverse basal trachea and the subsequent migration along it of the base of the medial trachea is influenced at all by the flight function of the wing, as the arrangement of the wing-veins does not appear to be modified by it. It should be remembered that the transverse basal trachea and the bases of the wing tracheæ are within the thorax of the adult insect, and are thus beyond the influence of the migrations of the wing-veins.

It is probable that these changes have to do with improving the air supply of the wing; but we have not sufficient data, as yet, to warrant a definite statement on this point. The important thing for the purposes of the present discussion is that one must know of this tendency on the part of the medial trachea to migrate along the transverse basal trachea in order to be able to recognize it in its various positions.

Entomological Laboratory,
Cornell University, December, 1897.

THE DAILY AND SEASONAL ACTIVITY OF A HIVE OF BEES.

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NOT long ago there was performed a series of experiments with a hive of bees by a French bee keeper, M. Leon Dufour, and published in one of the French apicultural journals, which is of considerable biological interest, showing, as it does, the relation of the activities of bees to the various conditions of honey flow, number of bees, season, etc. Although hives have been frequently weighed to show the daily increment of honey, this was the first attempt to find out what more might be learned by weighing. An hourly record of the weight of the hive used in the experiments was kept each day through the whole season. From the data obtained it was possible to plot daily and seasonal curves, some of which are here reproduced. Although the most was not made of the facts learned in making comparisons, enough was done to bring out the relations between the activity of the bees and the flow of nectar during the day, and the season, as well as the relation between the daily amount of nectar collected and the number of bees in the hive, and between the number of bees and the different seasons. The series of hourly weights also shows the rate at which the bees leave the hive, and when the number returning exceeds those departing. The facts learned by the experimenter might be carried further and comparisons made with hourly, daily, or seasonal changes of weather, and with the floral calendar of any particular locality, and it is with the hope that further experiments may be performed and carried out with greater detail that the account of Dufour's experiments is given here.

In these experiments the first morning weight was taken as the zero point for the day. As is evident in the curves reproduced in the figures, this weight was made sometimes at 5 A.M. and sometimes at 5.30, and sometimes later. The general

results, however, remain essentially the same. On May 8 this weight was taken at 5 A.M., and, as shown by the curve (Fig. 1), the weight of the hive slightly decreased during the next hour, or, in other words, the bees left it for their field labors in small numbers, but at 6 o'clock large numbers of the bees left, for during the succeeding hour the weight of the hive decreased by about 300 gm. From 7 o'clock until 8 the number of outgoing bees seemed to decrease, for the line of descent, as shown in the figure, is not quite so precipitous. This change, however, might and probably was due to returning bees. This brings out the crudity of the method of experimentation; for the curves, without an actual counting of bees, can show only relative numbers. This, however, is sufficient for practical purposes. At 8 o'clock the hive was over 500 gm. lighter than in the morning, and from this time until 9 it decreased in weight but little, reaching then the minimum forenoon weight of — 550 gm. From 9 o'clock until 10 the hive very slowly increased in weight, and then more rapidly, until at the end of the next hour the weight had risen to 380 gm. below the zero weight. Then it as rapidly decreased until noon, after which it slowly sank to 620 gm. below the morning weight, — the second minimum and

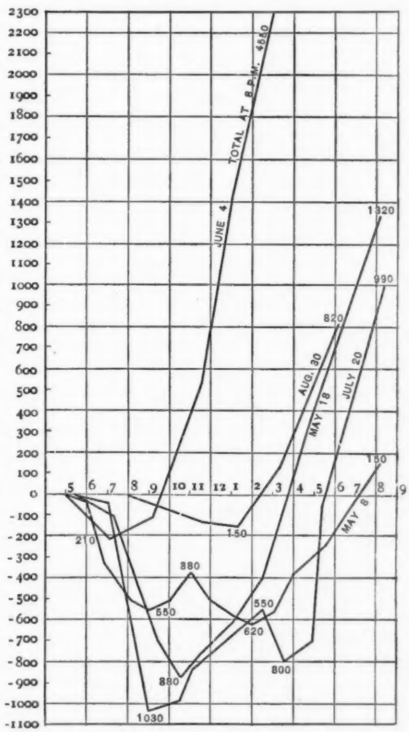


FIG. 1. — The horizontal lines show the weights in grams above and below the zero line (= the first morning weight). The vertical lines represent time.

the lowest for the day. From this time on the bees returned in large numbers evidently, and the hive consequently rose in weight, so that it passed the zero line at 7 o'clock, and reached 150 gm. above the morning weight one hour later, when the weighing was discontinued. This 150 gm. of course represents the amount of stores secured during the day.

The most remarkable feature of this curve is the sharp rise just before noon, thus making two points of minimum weight for the day. Several suggestions might be made to explain this peculiarity. Directly, it is certainly due to a large number of bees returning at about the same time. The small amount of honey gathered and stored during the day seems to indicate some relation with the nectar flow, which evidently was not great. Dufour, basing his remarks on experiments by Bonnier, explains the matter by pointing out that the flow of nectar varies during the day, and has a forenoon and an afternoon maximum flow, with an intervening period of small flow. According to these experiments, the nectar flows freely during the cooler portions of the day and much less so during the period of greatest heat, which ordinarily comes somewhat after midday. Of this change in the nectar flow the bees take advantage, and the peculiar curve which has been described is a result. This explanation is not, however, sufficient to account for the rise in this particular curve at 11 o'clock, for the reason that, as noted above, the hottest part of the day does not ordinarily occur in the forenoon. It seems, however, to explain the curve of July 20, where the intermediate rise reaches its maximum at 2.30. The difference between the two curves in respect to this rise may doubtless be explained by the difference in the total flow of nectar, which a comparison of the two curves shows to have been very much greater on July 20. The flow being small on May 8, it would consequently soon be exhausted, causing the bees to return earlier than they would have done had it been more abundant.

By May 18 conditions had evidently very materially changed. During the first one and one-half hours the bees left the hive slowly, although somewhat more rapidly than during the corresponding time on May 8. From a little after 7 o'clock they left

in large numbers, so that the weight of the hive sank rapidly to 880 gm. below the morning weight. From this time (10.30) the weight of the hive rose with almost as great rapidity as it had decreased, and passed the zero mark a little before 4 o'clock. It continued to rise until 8 P.M., when the record shows that 1320 gm. of stores had been added during the day.

The striking feature of this curve is the absence of the intermediate rise forming so strong a feature in the curve of May 8. But the difference seems explainable by the greater flow of nectar, evidently close at hand, which enabled the bees to quickly secure and return with their loads. The short flow of the middle of the day must certainly have been relatively very much more abundant than the aggregate power of the small laborers to dispose of it.

In the other curves there is shown some slowness in starting to work in the morning. On June 4 (Fig. 1) the decrease in weight was comparatively rapid and continued at the same rate at which it began. At 7 o'clock, or two hours from the first weight, the hive began to increase somewhat slowly in weight until a little past 9. Then it increased rapidly and crossed the zero line about half an hour later. By 8 P.M. 4550 gm. had been added to the morning weight of the hive.

The curve for July 20 is remarkable for the great decrease in weight, 1030 gm., and for the rapidity of the decrease, reaching, as it did, the limit at 9 A.M. Unlike the first minimum of May 8, this is the lowest of the two for the day. The reason for the difference is doubtless to be found in the greater flow of nectar on the latter day, as shown by the 990 gm. of stores added for the day. Finally, the very precipitous rise in weight, from about 700 gm. at 5 to about 60 below the morning weight, during the next 20 minutes seems somewhat remarkable.

If, now, the amount of stores be poor, it is evident that the different periods of strong honey flow for the season may be contrasted readily with the seasons of poor honey flow and with the blooming time of different species of nectar-bearing plants. In connection with what Dufour tells his readers, the curves here reproduced show two periods of good honey flow and two of poor honey flow. The first of the latter periods

began the season. It was followed by a period of good honey flow, extending from the latter part of May through June, and was due mostly to the blooming of acacias, which were evidently close at hand. The greater part of the summer was occupied by the second of the two periods of relatively poor honey flow, and was succeeded by the second of the other periods, beginning in the latter part of August and continuing into September. This, Dufour informs us, was mostly due to heather bloom.

A further comparison is to be made which brings out the relation of the number of bees in the hive to the different portions of the season. To make this comparison somewhat more accurate, curves are chosen (Fig. 2) that show almost the same amount of added stores for the day. On May 11 the workers were evidently numerous, since the hive decreased in weight by 730 gm., and if 10 bees be allowed to a gram there must have been more than 7300 bees at work. By July 18 they had increased greatly, so that, as shown by the minimum weight of 1510 gm. for the day, there were evidently more than 15,100 workers that left the hive, which is more than twice as many as on May 11. In August, as shown by the curve for August 21 and that for August 30 (Fig. 1), there were very few bees — on the former date only about 2000 that went to work. At first glance the curve for June 4 seems to show the same dearth of workers, but on May 18 they were relatively numerous, and, since it is scarcely possible that the workers had died off in great numbers between the two dates, the

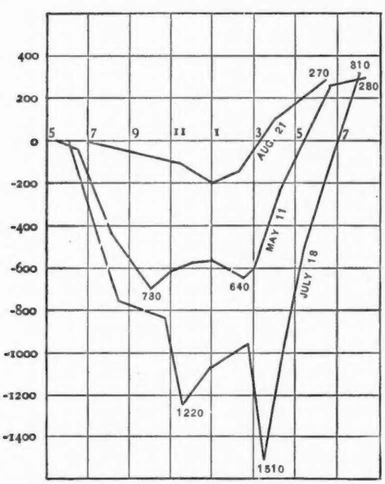


FIG. 2. — These curves are compared to show the differences in the number of bees in the hive.

small decrease in weight on June 4 seems to be more correctly attributed to the fact that the bees secured their stores so near by and returned so frequently and in such numbers that a very small (210 gm.) instead of a great decrease in weight resulted. The same explanation, also, may account for the curve crossing the zero line during the forenoon.

From the data that have been given one may conclude

1. That for the particular locality, Fontainebleau, where the weights were taken, there are four periods of honey flow, two characterized by an abundant and two by a poor flow, and that the activity of the bees through the abundant flow and that during the poor flow is characteristic in each case. During the poor flow there is a period of comparative inactivity during the middle of the day, corresponding apparently to a period of small flow of nectar, but during the abundant flow the activity of the bees is more or less constant through the whole day.

2. Aside from this midday activity the bees go and come steadily, and the hive, after the minimum weight is passed, increases in weight progressively and with comparative steadiness.

3. When the flow of nectar is poor, or comparatively so, the bees during the first hour or so leave the hive slowly. At the end of this time the rate of departure changes to a very rapid one, which continues with slight variation until the minimum weight is reached.

4. When the flow of nectar is abundant the rate of departure continues, as at the start, to be practically the same until the minimum is reached ; but this feature of the curve may be due also to the greater number of bees returning to the hive and the unloading of heavy loads more than to the bees maintaining a constant rate of departure.

5. When the flow is very abundant the outgoing bees do not reduce the weight of the hive to so great an extent as when the flow is relatively poor.

THE FIRST ANNUAL MEETING OF THE SOCIETY FOR PLANT MORPHOLOGY AND PHYSIOLOGY.

ERWIN F. SMITH.

For some years a move has been on foot to organize in the eastern United States a society for the study of the living plant, *i.e.*, to include all who are actively engaged in botanical studies not purely floristic. The plan was outlined at the meeting of the American Society of Naturalists in Philadelphia in 1895, but not enough botanists were present at that meeting to warrant any attempt at organization. A committee was, however, appointed, with Dr. James E. Humphrey as chairman. This committee reported at the Boston meeting of the American Society of Naturalists, whereupon the botanists present resolved to continue the agitation, and Dr. W. F. Ganong was authorized to see what could be done in 1897 at the Ithaca meeting of the American Society of Naturalists, with which body it was considered best to affiliate. After considerable correspondence, it was decided to call a preliminary meeting and determine wholly by its success or failure whether or not a society should be organized. A meeting was therefore called at Ithaca, N.Y., December 28 and 29. About thirty botanists were present, and much interest was manifested in the proposed new society. Thirty papers were listed on the program, and many of them were of unusual interest. It was therefore decided to complete the organization, which was done by the adoption of by-laws and the election of officers for the ensuing year. It was decided not to meet farther west than Buffalo or south than Washington; and, while it is believed that the bulk of the membership will naturally be drawn from the territory wherein the sessions are held, no geographical restriction was placed on membership. It was also decided that the society has no *raison d'être* unless it actually stands for what its title expresses, the purely floristic

work of the country having already ample outlet for its energies. Two standing committees were appointed, one on admissions and the other on programs. Abstracts of papers designed to be read before the society must be in the hands of the program committee, of which the Secretary-Treasurer is chairman, on or before December 1. No one shall be admitted to the society who has not published valuable papers or given satisfactory evidence of ability to do original work. For the present, at least, the society will meet with the American Society of Naturalists. Dr. W. G. Farlow was made President for 1898, and Prof. W. F. Ganong, Secretary-Treasurer. No proceedings will be published. The following new members were elected: Spalding, Webber, Swingle, Rowlee, Harshberger, Fairchild, Harper, Holm, Woods, Hicks, Pieters, Merrow, Porter. The old members, *i.e.*, the original committee, and such persons as were subsequently invited to become members of it, include Farlow, Goodale, Bailey, Atkinson, Smith, Galloway, Burt, Wilson, Sturgis, Richards, Cummings, Macfarlane, Thaxter, Penhallow, Robinson, Greenman, Stone, and Ganong. It is hoped that the end of the year will see the membership of the society increased to at least forty, and it is confidently believed that the ensuing meetings will be even more successful than the pleasant one which has just closed.

The following is a synopsis of the proceedings. In most cases the abstracts were made at my request by the authors themselves:

PROF. JOHN M. MACFARLANE: *A Mycorhiza in the Roots of the Liliaceous Genus Philesia.* This was the second recorded case of symbiosis between a liliaceous plant and a fungus. The genus Philesia grows in the damp humus soil of West Patagonia, and forms coralloid root masses. The fungus was sparingly present outside the roots, also in the epidermis and exocortex, but formed an abundant growth in the mesocortex, the cells of which rapidly became filled with coiled fungous hyphæ. The large spherical starch grains of these cells were acted on by the hyphæ, and were dissolved by solution rather than corrosion. A large amount of proteid material then appeared in the hyphæ. With growth of the root extremity the fungus steadily penetrated the mesocortex cells of the growing point, numerous hyphæ

being observed in the tenth to twelfth zone of cells behind the apex. Invariably the crystal cells were left untouched.

The close similarity of the above to cases recorded by Groom for Thismia, and by other authors, was referred to, but the conclusion was reached that, while the fungus might for many generations aid the host in the elaboration of protein compounds that were absorbed by the latter, ultimately, though very gradually, the fungus would prove a destructive agent.

Prof. Geo. F. Atkinson: *Studies on Some Mycelium and Fungi from a Coal Mine.* On the 14th of September the speaker explored abandoned portions of the Algonquin coal mine near Wilkesbarre, Pa., for the purpose of studying the mycelial formations on the doors in the gangways and on the wood props which are used to support weak places in the roof above. Several flashlight photographs were made of the remarkable displays of the mycelium, some four hundred feet below the surface, and of some of the fruit forms. Mature fruit collected has been determined as follows: *Polyporus versicolor*, *P. annosus*, *Coprinus micaceus*, *Stropharia sp.*, *Hymenochæte sp.*, *Merulius sp.*, etc. The paper was illustrated with lantern views. Some of the mycelial growths entirely covered areas one to two meters square, and were astonishingly luxuriant.

E. A. Burt: *Is there a Basidiomycetous Stage in the Life History of Some Ascomycetes?* The author described cases of close association of *Graphium giganteum* (Pk.), also known as *Dacryopsis ellisiana* (Berk.) Massee, with the discomycete *Lecanidion leptospermum* (Pk.), also known as *Holwaya tiliacea*, E. and E., and believes them to be different stages of the same plant. *Dacryopsis ellisiana* was described as a basidiomycete, and its hymenium and basidia figured by Massee in *Journal of Mycology*, 6: 181. The present study is being carried on, therefore, to decide whether *D. ellisiana* is a basidiomycetous stage of the ascomycete already named. If it is such a stage, the fact will have great significance in determining the relationship to each other of the great classes of fungi, basidiomycetes and ascomycetes.

Specimens of the Dacryopsis collected in August, October, November, and December show only conidial condition, and no true basidia and basidiospores. The conclusion is reached that, until further study demonstrates the presence of basidia, *Graphium giganteum* (Pk.), or *Dacryopsis ellisiana* (Berk.) Massee, should be regarded as a conidial rather than a basidiomycetous stage of the ascomycete *Lecanidion leptospermum* (Pk.).

David G. Fairchild: *Basidiobolus, a Fungus Derivative of the Conjugatæ.* Read by title.

Dr. G. E. Stone: *The Conjugation of Spirogyra.* Read by title.

Dr. G. E. Stone: *Chemotropism in the Peronosporeæ.* Read by title.

Dr. Erwin F. Smith: *Additional Notes on the Bacterial Brown Rot of Cabbages.* Field studies of this disease were made in Michigan, Wisconsin, Ohio, and New York in August, September, and October of 1897. These served to confirm the earlier published statements of the writer[1] respecting the manner of infection and the usual symptoms. A number of new facts which appear to have an important economic bearing were also brought to light. Some of these discoveries are as follows: (1) this disease is serious in many parts of the United States; (2) the greater part of the infections take place through natural openings of the plant, *i.e.*, through water pores located on the serratures of the leaves; (3) the disease is frequently disseminated by insects; (4) the wild mustard, *Brassica sinapistrum*, is one of the common host plants; (5) the disease is very frequently disseminated by man, *i.e.*, by making seed beds on infected soil, and transplanting the germs in infected seedlings to land previously free from it; (6) when a soil has once become infected, there is reason to believe that the germs are capable of living in it for a series of years and will attack cabbages which are planted on it; (7) the disease may be restricted by planting seed beds on healthy soil; by transplanting, as far as possible, to sod land, or at least to land not previously occupied by crucifers; by destroying wild mustards and parasitic insects; by removing badly affected plants bodily; and, in early stages of the disease, *i.e.*, when the disease has only recently passed out of the water-pore stage of infection, by removing affected leaves. A full account of the economic aspects of this disease has been published by the Department of Agriculture in the shape of a *Farmers' Bulletin*, which may be had on application. Cultures of the parasite and dried leaves and stems of cabbage showing the characteristic symptoms were passed around.

Dr. Erwin F. Smith: *Occurrence of Kramer's Bacterial Disease on Sugar Beets in the United States.* Attention was called to the existence in parts of the United States (Michigan, Wisconsin, etc.) of a disease of sugar beets much resembling, if not identical with, that

[1] *Science*, June 18, 1897, p. 963, and *Centralb. f. Bakt.*, 2 Abt., July 7, 1897, p. 284.

described by Kramer and Sorauer in 1891–92, and more recently by Busse.[1] The root shrivels in places, becomes very black, and finally breaks down here and there with the formation of a sticky exudate composed of bacteria. Cultures from the interior of blackened roots remained sterile. Cultures from the syrupy exudate yielded an organism resembling, so far as tested, that described by Busse as the cause of the disease. It is yet too early, however, to say whether the organism isolated is identical with *Bacillus betæ* Busse, or whether it is in any sense a true parasite. It appears worth mentioning in as much as it seems to be rather common, and destroys cane sugar and grape sugar with the formation of hydrogen, carbon dioxide, and an acid. Possibly this is one of the organisms which has given trouble to the chemists in sugar diffusion work, inverting the cane sugar and liberating gases (see *Journ. Soc. Chem. Ind.*, vol. xiv, p. 876). Cultures on steamed and raw beets, on steamed potato, and in fermentation tubes were exhibited. On steamed slices of sugar beet there is a copious production of gas, which, owing to the viscidity of the bacterial layer, remains for a considerable time imprisoned in little blisters.

DR. W. C. STURGIS: *On Some Aspects of Vegetable Pathology and the Conditions which Influence the Spread of Plant Diseases.* Paper withdrawn.

O. F. COOK and DAVID G. FAIRCHILD: *Fungus Gardening as Practiced by the Termites.* Read by title.

DR. W. P. WILSON: *On the Possibility of Securing Botanical and Other Material for Original Research through the Philadelphia Museums.* Read by title.

H. J. WEBBER: *Are Blepharoplasts Distinct from Centrosomes?* After discussing our present understanding of the structure and functions of the centrosome, the speaker pointed out that blepharoplasts are special organs of the spermatic cells of Zamia and Ginkgo, which, in certain stages of their development, somewhat resemble centrosomes. The presence of similar organs in the spermatic cells of certain Filicineæ and Equisetineæ have also been recently described by Belajeff. In Zamia and Ginkgo the blepharoplasts arise *de novo* in the cytoplasm of the generative cells and are located on opposite sides of the nucleus, about midway between the nuclear membrane and cell wall. They increase rapidly in size and are at

[1] *Zeit. f. Pflanzenkr.*, Bd. vii, p. 65.

first surrounded by very numerous radiating filaments of kinoplasm. The division of the generative cell results in the formation of two antherozoid cells, one blepharoplast being contained in each. During this division the blepharoplasts, which have previously lost their radiating filaments of kinoplasm, burst, and the outer membrane of each becomes gradually extended into a narrow helicoid spiral band, from which the motile cilia of the antherozoids are developed. In fecundation this ciliiferous band, formed from the blepharoplast, is left intact at the apex of the archegonium, the nucleus alone taking part. No bodies resembling centrosomes have yet been found in the divisions resulting in the formation of the pollen grain or in the divisions of the egg nucleus after fecundation.

In conclusion it was stated that the blepharoplasts resemble centrosomes: (1) in position, being located on opposite sides of the nucleus near the poles of the future spindle; (2) in having the kinoplasmic filaments focused upon them during the prophases of the division of the generative cell. They differ from typical centrosomes, however: (1) in arising *de novo* in the cytoplasm; (2) in growing to comparatively enormous size; (3) in not forming the center of an aster at the poles of the spindle during karyokinesis; (4) in having a differentiated external membrane and contents; (5) in bursting and growing into a greatly extended cilia-bearing band, the formation of which is evidently their primary function; (6) in their non-continuity from cell to cell. The conclusion reached by the speaker was that in our present understanding of centrosomes the blepharoplasts must be considered as distinct organs.

Dr. Robert A. Harper: *Spore Formation in Some Sporangia.* Protoplasmic cleavage and spore formation in types from the genera Synchitrium, Pilobolus, and Sporodinia were described. The division of the multinucleated sporeplasm is neither simultaneous nor by repeated bipartitions, but is accomplished by the progressive growth of narrow cleavage furrows from the surface inwards. In *Synchitrium decipiens* this results in the formation of uninucleated spores, which, by subsequent division of their nuclei, become the resting zoösporangia of this species. In *Pilobolus crystallinus* a similar progressive cleavage produces oval or sausage-shaped masses, which have one or several nuclei. These nuclei now divide, and the plasma masses in which they are also divide by constriction, thus forming ultimately the definitive binucleated spores. In Sporodinia the process is much abbreviated, the primary cleavage furrows simply dividing the protoplasm into relatively few and very unequal multinucleated masses,

which round themselves up and are set free at once as spores. In Pilobolus the so-called collar is composed of a slime which is readily distinguished from protoplasm, both by its structure and staining reactions. Cleavage consists in the ingrowth of the plasma membrane. The whole process of spore formation in these sporanges is fundamentally different from that in the ascus, and is strong evidence that ascus and sporangium are not homologous structures.

WALTER T. SWINGLE: *Two New Organs of the Plant Cell.* The author announced the finding of two new organs or organoids; the one, vibrioid, being abundant in the superficial layer of the cytoplasm of some Saprolegniaceæ and some Florideæ, the other being a central body in the developing egg of *Albugo candidus.* The vibrioids are slender, cylindric, sharply delimited bodies about the size of many common bacilli, but exhibiting rather slow bending or undulatory proper motions in addition to transitory movements, which are probably passive and due to the streaming of the cytoplasm in which they are imbedded. They are fixed well by ordinary killing agents, and when stained are very sharply differentiated from the surrounding cytoplasm. They can also be seen in the living cell. Their appearance suggests that they may be minute entoparasites, but their constant occurrence in plants in all stages of development and from widely separated localities militates against this view. Their function is unknown.

The other new organoid is a nearly spherical body, located at one end of the egg nucleus of *Albugo candidus.* It is often a little flattened on the side adjoining the nucleus, is not very sharply delimited from the cytoplasm, but stains differentially. It seems to be more or less granular in structure; it appears just before delimitation of the egg within the oögonium, and disappears after fusion of the male and female nuclei; it probably plays some part in these two phenomena.

Both of the organoids have been observed before, but were not correctly described by previous writers.

B. M. DUGGAR: *Notes upon the Archesporium and Nucleus of Bignonia.* In the microsporangium the archesporium occupies a single boat-shaped layer. The primitive archesporium is differentiated by periclinal division in certain regions of the hypodermal layer, the next divisions in the latter giving rise to the tapetum on the outer side, and the final division of the succeeding hypodermal layer developing that layer often becoming the fibrillar endothecium of authors. In Bignonia there is no fibrillar structure, and, in general, no further

periclinal divisions in the regions mentioned. The definitive archesporium is formed by not more than a single anticlinal division of the primitive archesporial cells.

The macrosporic archesporium apparently develops no primary tapetum, divides simultaneously from the two-celled stage, and the third or fourth cell becomes the definitive embryo sac mother cell.

The archesporial nucleus, especially, is peculiar in the large nucleolar-like structure, which is evidently not homogeneous in structure, a portion of it taking the gentian in the Flemming combination.

WALTER T. SWINGLE: *Some Theories of Heredity and of the Origin of Species Considered in Relation to the Phenomena of Hybridization.* Owing to limited time, the speaker treated only the first portion of his theme, *viz.*, the bearing of the facts of hybridization on some theories of heredity. It was pointed out that Weismann's theory of reduction of chromosomes, though giving a plausible explanation of the differences observed between the first (uniform) and second (polymorphic) generations of most hybrids, is not in accord with the observed phenomena of spore and pollen formation in higher plants, and, moreover, fails to account for the extreme polymorphism often observed in the first generation of hybrids of races of cultivated plants or closely related species, as, for example, some racial hybrids of maize and some specific hybrids of Lychnis and Digitalis. Mr. Swingle considered it necessary to assume in some such cases, at least, a predetermination of the characters of the hybrid at the time of fusion of the male and female nuclei.

Since the male and female chromosomes probably persist side by side unchanged in number, and possibly unchanged in quality during the whole of the ontogeny of the hybrid (reduction not occurring until the close of the first generation), it is therefore necessary to assume, in order to explain the observed fact of divergence of character in the first generation of some hybrids, that the influence exerted during ontogeny of the hybrid by the material bearers of heredity is, at least in some cases, a function of their relative positions, and, further, that in most cases the relative positions of these bearers of heredity, as determined at the moment of fusion of the male and female nuclei, would persist unchanged throughout ontogeny of the offspring. Some exceptional cases, such as reversions to the one or the other parent form of a larger or smaller part of the hybrid, would be explained by assuming some change in the disposition of the units of hereditary substance, whereby they assumed a new posi-

tion of partial or complete stability. It was suggested that possibly the difference between uniform and polymorphic hybrids of the first generation is due to a more complete intermingling of the hereditary particles in case of polymorphic hybrids (offspring of closely related organisms), whereby many differing combinations would be possible, and, in case of uniform hybrids (mostly offspring of distinct species or very different races of the same species), to greater or less aversion to commingling between the two more diverse sorts of particles, whereby but one uniform and stable configuration would result, allowing both sorts of hereditary substance to act equally.

Xenia, or the communication of the paternal characters to parts of the mother plant in the immediate neighborhood of the developing embryo, was held to be well established in case of some races of maize by the work of Dudley, Savi, de Vilmorin, Hildebrand, Körnicke, Sturtevant, Burrill, Kellerman and Swingle, McCluer, Tracy, Hays, and others, and in case of some races of peas by the work of Wiegmann, Gärtner, Berkeley, Laxton, and Darwin. The converse phenomena of the mother plant influencing the characters of the developing embryo is occasionally reported; for instance, in hybrids of Digitalis, by Gärtner, and in hybrids of Nymphæa, by Caspary.

These phenomena are inexplicable by the current theories of heredity, and perhaps in consequence have been neglected. They necessitate the assumption that hereditary influences can be transported from cell to cell for some distance. It was suggested that this transport may occur either along the intercellular filaments which pass through the walls, or by means of diffusible substances capable of acting on the hereditary particles of distant cells. Townsend's proof of the conduction of the stimulus which results in wall formation over long, slender threads of protoplasm in plasmolyzed cells may be considered as hinting the possibility of the former explanation, while Beijerinck's claim that the developing larvæ of some gall insects secrete substances which diffuse into and control the ontogeny of neighboring meristematic or partially developed tissue cells of the host plant foreshadows the latter hypothesis.

DR. G. E. STONE: *Influence of Electricity on Plants.* Read by title.

ALBERT F. WOODS: *Variable Reaction of Plants and Animals to Hydrocyanic Acid.* Experiments cover a period of three years. The plants and animals were exposed in air-tight chambers of known cubic

contents for a given period to a definite amount of gas obtained from a solution of 98% (*i.e.*, c. p.) potassic cyanide in 50% sulphuric acid, $KCN + H_2SO_4 +$ aq. Plants of the Coleus group which we have tried will stand in all stages of growth the gas produced from $\frac{15}{100}$ of a gram of 98% cyanide of potassium per each cubic foot of space for 25 minutes. A longer exposure, even for so short a time as 5 or 10 minutes, results in more or less injury, and exposure to the gas from $\frac{20}{100}$ gram per cubic foot for 25 minutes also results in injury. In the latter case, if the time is cut down to 10 minutes the plants may stand the increased dose without injury. The ratio between the doses and the time is not constant. The plants can endure strong doses for a very short time much better than they can a weak dose for a long time. Under conditions where the stomata of the plant are closed, it can resist the gas for a much longer period than it can where they are open. The temperature of the chamber also has an important effect. If it is high, it increases the diffusibility of the gas and decreases the time which the plant can be exposed without injury. If the temperature is low, the time may be lengthened.

Ferns, *e.g.*, Davallias and Adiantums, are able to withstand a slightly longer treatment than Coleus. Even the very youngest developing fronds are not injured at the upper limit of the treatment which would injure the young leaves of Coleus. There are a large number of plants of different families which seem to be able to endure exposure, as indicated for Coleus and Adiantum, without injury. Tomatoes, on the contrary, are very sensitive. All the young growth is killed by an exposure of 15 minutes to the gas from $\frac{15}{100}$ of a gram of 98% KCN per cubic foot of space. In fact, it is hardly possible to give these plants any dose so small that it will not injure some of the young growth. The young growth of roses is also remarkably sensitive, it being almost impossible to treat them without injury. Different varieties of roses, however, seem to differ in this respect. The older leaves of tomatoes and roses are much less susceptible. A curious effect of the poison was noted on tobacco, on *Lilium candidum*, and on tomatoes, where the dose was not great enough to kill the plants, but simply to injure them slightly; all the affected cells lost their chlorophyll, and, although they continued to divide and grow, they were colorless, producing yellowish white blotches in the leaves, especially along the veins. In case of woody stems the cells immediately under the cambium, *viz.*, the youngest wood cells, were most sensitive. In many cases these were killed, much as if by frost, but the stems continued their growth.

Variations of a similar nature were noted also in insects, and some of these are well known to entomologists who use cyanide bottles. Spiders and all of that group seem to be particularly resistant to the poison. The mites are the most resistant organisms thus far studied, but even among species of aphides some are much more sensitive than others. The red mite (*Tetranychus telarius*) is very resistant. In cases where complete paralysis is produced and there are no signs of life for several hours mites frequently recover. Some of the higher animals also behave in the same way.

GILBERT H. HICKS: *Effect of Light on the Germination of Seeds*. Read by title.

A. J. PIETERS: *Effect of Alternating Dryness and Moisture on the Germination of Some Seeds*. The species experimented with were *Chenopodium album*, *Daucus carota*, *Anthemis cotula*, *Arctium lappa*, *Cichorium intybus*, *Dianthus armeria*, *Echium vulgare*, *Datura tatula*, *Malva rotundifolia*, and *Verbascum blattaria*. Two pots were devoted to each species. After the seeds were sown the pots were under uniform and like conditions, the soil being kept continuously moist. After a long period, during which germination had practically ceased, the soil in one of the two pots was allowed to become thoroughly dry, and remained so for two weeks. It was then moistened regularly, whereupon many seeds germinated. This was true of all the species mentioned. Two examples are selected at random from the list. *Daucus carota:* During the first 39 days pot *A* germinated 14%, and pot *B* 15%. No further germinations for 98 days. *A* was then kept dry for 14 days; *B* moist as usual. Germination began in *A* 2 days after watering, and in 4 days *A* germinated 15%, while in the previous 18 days *B* had germinated 0. Both pots were subsequently left dry from August 7 to September 8, and then moistened. Germination in both pots began September 11, and in 17 days *A* germinated 9%; *B*, 30%. *Dianthus armeria:* In first 111 days *A* germinated 32%; *B*, 42%. *A* was then dried 14 days, while *B* was continued moist. Beginning July 27, *A* was moistened regularly. On July 30, germination began in *A*, and in 10 days *A* germinated 52%. During the previous 24 days *B* germinated 0. Both pots were dry from August 7 to September 8, then both were regularly moistened. Germination began September 13. In 15 days *A* germinated 2%, and *B* 40%. Equally striking results were obtained with other species. In many cases germination began in the dried-out pots within 48 hours, and in some cases within 24 hours after the watering. A few other

species which had shown no germinations in the moist soil were not affected by this treatment. These experiments will be repeated and extended before final publication.

PROF. GEO. F. ATKINSON: *Experiments on the Morphology of Arisæma triphyllum.* Female, male, and neuter plants, the history of which was known by growing them in pots for one season, were potted, some in rich soil and others in poor soil, the object being to change them from male to female, etc., by varying amounts of nutriment. Male plants in rich soil were in one year changed to female, and large neuter plants in rich soil were changed to female.

In a second series, large two-leaved female plants with large corms were selected at the time the rudiment of the flowers was formed. The corms were cut so as to remove all but a small portion in connection with the bud and then set out. By removal in this manner of the larger part of the stored food, the plants were changed to male. A collection of these plants was exhibited.

DR. W. F. GANONG: *Upon Polyembryony and its Morphology in Opuntia vulgaris Mill.* The author has found this species markedly polyembryonic, the polyembryony having a double morphological basis. One set of embryos comes from a mass of tissue which appears to develop from the fertilized egg cell, and others spring from the wall of the embryo sac and seem to arise from endosperm cells. If this be true, it is a mode of origin hitherto unknown. The literature of the subject was summarized, and some remarks given upon the significance of polyembryony. Many species of cactus were worked over (eighty or ninety), and no other cases observed.

DR. W. F. GANONG: *Contributions to the Morphology and Biology of the Cactaceæ. Part II, The Comparative Morphology of the Embryos and Seedlings.* The paper is a continuation of the author's earlier studies upon this family. It describes and figures germinated embryos of most of the genera and the more important species, discusses the germination and growth of the embryos, their form, size, and color factors, and the features they show of importance for the determination of the phylogeny of the genera, the development of the seedlings, and the unfolding of the peculiar morphological features of the adult plants. Contrary to Pfeifer, the morphology of the group is of systematic importance. A tree of descent was exhibited. Anhalonium and some other genera were shown to belong with genera from which they have heretofore been widely separated. Many interesting drawings were exhibited.

DR. W. W. ROWLEE: *The Morphological Significance of the Lodicules of Grasses.* This study was based on an examination of bamboo flowers, in which genus three to six lodicules are present. In floral structures the bamboos are believed to represent the primitive type of grass flower. Evidence obtained from an examination of numerous sections of the bamboo flower indicate that the lodicules must be regarded as the remnants of a perianth. The three lodicules in Arundinaria alternate on the axis with the stamens, and may, therefore, be considered the inner whorl, or petals. The stamens are directly opposite the midribs of the carpels, and indicate that the inner whorl of stamens, present in some bamboos, is suppressed in Arundinaria. Hackel, as is well known, interpreted the lodicules as distichous bracts. The paper was illustrated by lantern slides.

DR. LUCY L. W. WILSON: *Observations on the American Squawroot (Conopholis Americana Wallr.).* An exhaustive study of the vegetative and reproductive parts has been made, but an account of the former only was read. The invariable host plant is the oak. The extreme degradation of the parasite and the intimate relation between it and the oak roots caused the author to compare it with members of the Balanophoreæ and Rafflesiaceæ, rather than with parasitic members of the Scrophulariaceæ. The seedling parasite seemed early to attack young oak roots, and steadily grew for ten to twelve years until a huge mass six inches across might be formed. This mass was characterized chiefly by the abundance of sclerenchyma patches developed by the oak host through the irritant action of the invading parasite. The presence of stomata on the stem and their absence on the scale leaves was pointed out, while the double circle of bundles traversing the flowering stem is peculiar in that the xylem of one of these sets of bundles faces the xylem in the other.

DR. JOHN W. HARSHBERGER: *Water Storage and Conduction in Senecio præcox DC. from Mexico. Senecio præcox* (Cav.) DC. is a plant with a succulent, woody, cylindrical stem growing on lava beds in the valley of Mexico. It has clustered leaves at the top of the stem and stores up water in disk-like plates of pith. During the dry season the plant develops its corymb of composite flowers, and in doing so uses the water stored up in the pith. The loss of this water is prevented during the dry season by the fall of the leaves and by a protective cork and balsam, the latter secreted in the exocortex and endocortex. The leaves show no xerophytic structure. The water stored in the turgid disks of pith is gradually conducted by the woody

cells and tracheids to the growing point. That the water in the pith is a reserve supply is shown by examination of a piece of stem, which was still alive and sending out small green leaves and short shoots, although it had been cut and in a dry place for over sixteen months. In this stem the turgid disks of pith were contracted into parchment-like membranes or partitions. Conduction of water in the stem was accomplished without the assistance of root pressure and without the aid, to any appreciable extent, of the transpiration from the extremely small leafy crown.

K. M. Wiegand: *Notes on the Embryology of Potamogeton. Potamogeton pauciflorus* was studied with regard to the origin and development of the embryo sac, fertilization, and the development of the embryo. The embryo sac was found to arise in the normal manner for monocotyledons, *viz.*, from the subepidermal cell after the cutting off of a tapetal cell. The egg apparatus and antipodals were, however, somewhat abnormal. Although the normal number of cells in each was present, they were formed irregularly. The polar nucleus and first and second synergides seem to have been cut off successively from the mother nucleus of the egg. The synergides disappear almost immediately. A similar irregularity was found in the antipodals; but the most interesting feature, perhaps, was the fact that the definitive nucleus cuts off a very large basal nucleus, as in Sagittaria, before endosperm formation proceeds in the upper portion of the sac.

Dr. Adeline Schively: *Recent Experiments and Observations on Fruit Production in Amphicarpæa monoica.* Her published observations show that minute aerial cleistogamous flowers when buried produce one-seeded "nuts" with soft fruit and seed coats, instead of the typical two to three-seeded pods with indurated walls.

She now shows that when purple flowers are buried, in the bud state, while still attached to the plant, or at any period up to the time of fertilization, perfect underground "nuts" mature instead of three to four-seeded pods. Various conclusions were drawn as to the powerful action of environmental agents in determining the size, shape, and consistence of the seed, the induration of its coats, and the number of seeds that might be produced.

Dr. Martha Bunting: *On the Formation of Cork Tissue in the Roots of the Rosaceæ.* Starting with observations on *Geum urbanum* and *Geum rivale* made by Professor Macfarlane in 1890, where intercellular spaces were shown to exist between the cork cells, she

proved this condition to be typical for all herbaceous and shrubby species examined, but to be absent in roots of arborescent species. She described the alternation of a flattened, usually pigmented, layer of cells with one to three layers of rounded cells in each annual ring, the flattened layer being the last produced each season. Protoplasm, nuclei, and starch grains exist in cork zones four to five rings removed outside the phellogen.

Miss Caroline Thompson: *The Structure and Development of Internal Phloem in Gelsemium sempervirens Ait.* The phloem originates as four longitudinal tracts in the primary meristem and steadily increases, until by the eighth or tenth year it has entirely pressed together and destroyed the pith. During the first year nourishment of the pith ceases, owing to the differentiation of two layers of cells, which were referred to as the "phloem sheath."

A remarkable distribution of the internal phloem was shown to exist in the petiole, at the base of which a bicollateral bundle arrangement exists, but this quickly changes to the ordinary collateral relation by the passage of the upper (internal) phloem through the xylem of the petiole. Each bundle in passing out into the petiole subdivides into three parts, two of which remain in the stem and soon reunite, while the third passes out and behaves as above described.

From the second year onward, the internal phloem patches of the stem show areas of crushed and obliterated tissue where the previously formed phloem has been pushed inwards by the younger elements. In older stems eight large phloem patches, formed by division of the original four, entirely fill up the pith area.

SOME CHARACTERISTICS OF THE FOOTHILL VEGETATION OF WESTERN NEBRASKA.[1]

CHARLES E. BESSEY.

In another paper read before this section[2] I have spoken of the general features of the foothill portions of Nebraska, and I need do no more here than to say that the foothill region includes a belt from 100 to 200 kilometers in width, covering the extreme western counties and lying for the most part west of the 102d meridian. It is characterized physically by two long ridges which extend out from the Wyoming Mountains to the eastward. The northern one is Pine Ridge, with an elevation of about 1500 meters, and the southern one Cheyenne Ridge, with an elevation of 1700 meters. Each slopes gradually to lower levels, and, after 200 or 300 kilometers, they are raised but little above the surrounding country. It must be borne in mind that the whole of the western portion of the state is greatly uplifted, the general level for the last one-fourth of the surface being fully 1200 meters above the sea.

A recent botanical journey of about 175 kilometers in this region enables me to present at this time a few features of the vegetation which have not hitherto been particularly noticed.

At Alliance in Box Butte County, the point of beginning, the surface is a gently undulating plain, with an elevation of 1200 meters above sea level. Here, as far as the eye can reach, there are no native trees whatever and scarcely any shrubs. The plants which dominate everywhere are *Agropyron pseudorepens*, *Stipa comata*, *Bouteloua oligostachya*, and *Bulbilis dactyloides*, with *Opuntia mesacantha* and *Cactus viviparus* abundantly scattered among the grasses. *Lepidium intermedium* entered into these grass formations quite constantly, and in some places constituted nearly, if not quite, one-half of the vegetation.

[1] Read before section G of the American Association for the Advancement of Science, Aug. 11, 1897.

[2] "Are the Trees Receding from the Nebraska Plains?" since published in *Garden and Forest*, Nov. 17, 1897.

For fifty kilometers the vegetation is of this monotonous character, the monotony intensified by the straw color now assumed by the dry vegetation. Only when we cross the broad valley of Bluewater Creek do we find a marked departure from the Agropyron-Stipa-Bouteloua-Lepidium formation. The increased moisture has enabled other grasses to push their way in, especially *Sporobolus aroides*, and this with Agropyron, which here is taller and quite green, give a refreshing color to the stretch of level land on each side of the creek. We cross a stretch of rounded sand hills over which the vegetation is still more sparse, but yet it is only a modified form of the Agropyron-Stipa-Bouteloua-Lepidium formation. As we enter and as we pass out of these dry hills, we cross a belt, or zone, of *Artemisia filifolia*, which begins and ends with marked abruptness.

The valley of the North Platte, thirty kilometers from the western boundary of the state, is from six to sixteen kilometers in breadth, and here, on account of the general introduction of cultivated plants under irrigation, the botanist finds little of the original vegetation. The river banks and the sandy islands scattered here and there in the rapid current are fringed with young willows (probably *Salix nigra*) and buffalo berry, but there is no heavy body of woodland, as we should find under similar conditions in the eastern part of the state. Doubtless the greater elevation (1100 meters) above sea level has much to do with this absence of trees along the banks of the great river, which is fully a kilometer in breadth.

Upon crossing the river we soon begin the ascent of Cheyenne Ridge. In its narrow cañons, which open to the north, we find cottonwood (*Populus deltoides*), Rydberg's cottonwood (*Populus acuminata*), almond willow (*Salix amygdaloides*), box-elder (*Acer negundo*), plum (*Prunus americana*), hackberry (*Celtis occidentalis*), and red cedar (*Juniperus virginiana*), while on the sides of the bluffs were scattered specimens of pine (*Pinus ponderosa scopulorum*). Here grow side by side the western shrubs, *Rhus trilobata, Prunus demissa, Rosa fendleri, Ribes aureum, Lepargyræa argentea*, and the eastern *Symphoricarpos occidentalis, Parthenocissus quinquefolia*, and *Vitis vulpina*. Passing still further up the side of the ridge, we find the smaller moun-

tain mahogany (*Cercocarpus parvifolius*) in great abundance on the steep slopes. Here the pine is the principal tree, growing abundantly in the deep cañons and upon the exposed mesa-like summits of the rocky spurs.

After we reach the top of Cheyenne Ridge, we find broad stretches of grassy meadow land which are comparable to the mountain meadows of the great range to the westward; and yet here the summits, which here and there rise 100 meters or more above the general elevation, are capped and fringed with pines. The Wildcat Mountains constitute one of these series of higher summits, attaining an altitude of fully 1700 meters, and their summits and slopes, as well as tortuous cañons, bear pine trees here massed and there widely scattered. From the highest point of Cheyenne Ridge, as we pass southward, there is a gradual return to the type of Agropyron-Stipa-Bouteloua-Lepidium which we found on the high plains north of the North Platte River. As we pass ridge after ridge, each a little lower than the preceding, we gradually lower our elevation until we run down into the valley of the Lodge Pole River, 1450 meters above the sea. The last ten kilometers have nearly duplicated the floral covering of the Box Butte Plains, with somewhat less of the effects of aridity in its general aspect, and with here and there a cottonwood, box-elder, or willow tree along the river to relieve the monotony of the landscape.

BRIEFER ARTICLES.

ADVENTITIOUS BUDS ON LEAVES OF DROSERA ROTUNDIFOLIA.

A. J. GROUT.

WHEN collecting plants of *Drosera rotundifolia* for class use, I found several leaves bearing numerous (from two to ten) young plants on their upper surfaces (Fig. 1). This fact was first noted about Sept. 15, 1897.

So far as I can learn, this peculiarity of the sun dew has escaped observation until the present year. At the time I made the discovery I knew of no other similar observations, but have since learned that Mr. James A. Graves,[1] of Susquehanna, Pa., has noted the same thing this fall. That these facts have never before been noticed seems all the more remarkable since *Drosera rotundifolia* has been made the object of such careful scrutiny by Darwin and others because of its carnivorous habits.

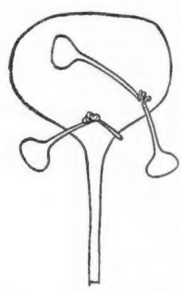


FIG. 1. — Leaf of *Drosera rotundifolia* with two young plants.

The most favorable spots for this peculiar development seemed to be among dense masses of Sphagnum, and the leaves producing the adventitious buds lay directly upon the wet moss. A few of the leaves had entirely severed their connection with the old plant, but no roots had developed in the young plants at the stage represented in the figure. Mr. Graves's Drosera developed the adventitious buds in a moist chamber.

The occurrence of the adventitious buds in such wet places suggests that the past extremely wet season may explain their discovery at this particular time; that is, the unusual amount of moisture has caused the formation of an unusual number of buds.

Another interesting fact observed was the occurrence of the peculiar glandular hairs of the leaves a short distance up on the stems of the young plants, as if the tissues of the stem still retained some of the peculiarities of leaf tissues.

[1] *The Plant World*, vol. i, no. 2.

Sections through the leaf and base of young stems have been made, but the apparatus at hand does not permit of a section thin enough to give structural details. The organic connection between the leaf and the base of the young stem is clearly shown, and the young plant evidently starts in connection with the fibro-vascular bundles of the leaf, but my sections do not clearly show the nature of the connection.

The cells of the very base of the young stem and the adjoining leaf cells were crowded with chlorophyll grains, while there were very few in the other leaf cells, showing clearly the much greater constructive activity (anabolism) of these tissues.

PLYMOUTH, N. H.

NOTES ON THE FOSSIL MAMMALIA OF EUROPE.

CHARLES EARLE.

VI.

Remarks on the Fossil Tapiroids of France.

As far as our paleontological knowledge stands in regard to the evolution of the modern tapirs, this phylum arose in Europe and America at about the same time. In America we find in the Bridger the genus Isectolophus, which is considered to represent one of the stages leading to Tapirus.

Prof. Albert Gaudry has lately published an important paper[1] on the evolution of the teeth of fossil Tapiroids and refers remains found in the Middle Eocene of Argenton, France, to the American genus Colodon, which he includes in the tapir phylum. Now, in the first place, Colodon comes from the Oligocene, or White River Beds, whereas the beds at Argenton are equal to the Middle Eocene, or Bridger. The teeth which Professor Gaudry has referred to *Colodon minimus*, in my opinion, should be identified as those of the American genus Isectolophus, or a very closely related genus. This is more in harmony with the origin of the tapir's tooth, as in Colodon the metacone is concave, whereas in Isectolophus this cusp is convex, like that of the recent tapir.

[1] La dentition des Ancêstres des Tapirs, *Bull. Soc. Geog. de France*, p. 315. 1897.

In fact, I am not at all certain that Colodon is found in Europe, even in beds above the Eocene. The *Protapirus douvillei*, which has been referred by some American paleontologists to Colodon, is, as I have shown,[1] really a true tapir and belongs in the genus Protapirus, which is one of the generic links leading to Tapirus.

Again, *Hyrachyus intermedius* of Filhol has been placed by M. Gaudry as a synonym of *Colodon minimus*. I can hardly agree with my learned friend of the Jardin des Plantes in this identification, and I think the jaw and teeth referred by Filhol to the genus Hyrachyus were correctly identified.

In the jaw of the French species of Hyrachyus, described by M. Filhol, the number and structure of the teeth are the same as in the typical American species of this genus, and there is no third lobe on the last lower molar. The measurements of the jaw and teeth of *H. intermedius* correspond nearly exactly with those of *Hyrachyus agrarius* of the Bridger.

The presence of such typical American Middle Eocene genera as Hyrachyus and Isectolophus in the Eocene of Argenton, France, demonstrates how closely this fauna is related to that of the Bridger.

So far as I am aware, the larger species of Lophiodon are not found at Argenton, *L. isselensis* coming from Issel. We might conclude from this that the Argenton beds are really earlier than those of Issel, and this would harmonize better with our ideas of the dental morphology of the tapirs, as it is more probable that the types with a convex metacone, Isectolophus, gave origin to both tapirs and lophiodonts than that the latter were ancestral to the tapirs. The typical forms of Lophiodon, as *L. isselensis*, probably led to no permanent results in regard to evolving higher genera.

In conclusion, the evidence is now pretty conclusive that Hyrachyus is found at Argenton, and a decided advance has been made by Professor Gaudry in the removal of one of the small species of Lophiodon from that genus, but whether the view is correct that it is a species of Isectolophus remains to be seen. The third species of Lophiodon which was referred by Cuvier to this genus is now placed by Professor Gaudry in Propalæotherium. The mist has now considerably cleared away in regard to What is Lophiodon? In France, at least, all of the small species have been accounted for and referred probably to their proper genera.

[1] *Science*, Dec. 25, 1896.

VII.

Note on the Structure of the Skull in Dichodon.

The genus Dichodon has been recorded from the Eòcene of Hordwell, England, at Egerkingen by Rütimeyer, and also is found in the Siderolithic du Mauremont. While at Paris in 1895, I had the opportunity of examining part of a skull from the Phosphorites, labeled *Dacrytherium cayluxi.* I at once noticed the modernization of this skull and the characters of the teeth, and immediately referred it to that little-known genus Dichodon of Owen. This genus has not, I believe, been recorded before from the Phosphorites of France.

In Dichodon the fourth upper premolar is completely molariform: it resembles Agriochoerus in this respect somewhat, but in the latter this tooth has not developed the postero-internal cusp. Dichodon stands unique among Artiodactyles in the complex structure of the last premolar.

The facial part of the skull in Dichodon is high and strongly compressed. The anterior narial openings are not as terminal in position as in the Anoplotheroids, with a corresponding reduction in the nasal bones, obliquity and enlargement of the nares. As compared with Dacrytherium, there is no preorbital fossa, and the facial part of the skull in Dichodon is much more modernized than in the former genus.

In comparison with modern selenodont Artiodactyla, the anterior portion of the skull in Dichodon closely resembles that of the Tylopoda and departs widely from the primitive type found in the Anoplotheres.

With the exception of the closed dental series in Dichodon, this genus has apparently little near relationship to the Anoplotheres, but is a much higher type and more nearly related to the true Selenodonts.

New Rochelle, N. Y.,
January 24, 1898.

EDITORIALS.

A New Biological Journal. — We have the pleasure of recording the advent of another excellent periodical from France devoted to biology. *L'Intermediaire des Biologistes, organe international de Zoologie, Botanique, Physiologie, et Psychologie*, the first number of which appeared November 5, is edited by Prof. Alfred Binet, with the assistance of Dr. Victor Henri and an editorial committee of thirty-four, including Profs. J. M. Baldwin and C. S. Minot from America. The journal, which is to appear semi-monthly, cherishes the high ideal of becoming the medium of communication between the members of the great family of biologists scattered in all countries. The immediate practical aim is that of furnishing to biologists information of interest to them as investigators. This information will be afforded, first, by a department of "Questions and Answers," and, secondly, by summaries of the biological periodicals. In addition, a brief space may be devoted to original articles and preliminaries. The number now before us contains "An Appeal to Physiologists," by E. J. Marey, for the establishment of a commission to make the types of instruments used in physiological work uniform; forty-six queries, largely in psychology, nearly all instructive by their suggestiveness; bibliographic lists of contents of periodicals, eight pages; three new pieces of physiological apparatus, with illustrations. Of the importance of such a journal as this we have no doubt. In how far it will serve the working naturalist who wants certain information is yet to appear. Generally he wants it quickly; but not infrequently the queries will relate to a life work, when he can afford to wait, as Darwin did, months and even years for the answers to his questionings. But whatever this journal does towards uniting biologists, towards establishing a habit of mutual dependence and aid, will not fail to advance the science.

Scientific Names. — There has recently come into our hands a small paper of no little value to systematic naturalists. We refer to Professor Walter Miller's "Scientific Names of Latin and Greek Derivation," published in the *Proceedings of the California Academy of Science* and reprinted by the Stanford University. The paper should be a *vade mecum*, studied and restudied by every person who is in danger of describing new genera and new species. Were its

teachings followed we should not have our tastes shocked by such hybrid names as Gillichthys; we should no longer have to see feminine adjectives coupled with masculine nouns; we should no longer be in doubt as to whether Alcyonaria or Halcyonaria, Aplodinotus or Haplodinotus was the preferable form.

We wish, however, to make use of the paper as a text, rather than for a regular review. From one standpoint the appearance of this paper is to be regretted. There is danger of its falling into the hands of those who will feel it their duty to reform nomenclature in accordance with the rules there laid down and thus inflict upon a suffering world a new series of useless terms. There are people who cannot realize that our system of systematic nomenclature is not an end but a means. It is really the foundation of our book-keeping, and to change this book-keeping from day to day is far from facilitating actual work. We are told that the whole endeavor of the systematic purists is to result in permanence, but we have been waiting for this permanence now these many years, and, so far as we can see, it is as far off as ever.

We have no fault to find with the law of priority, no fault with the rule that names shall be formed in consonance with the laws of philology. What we do find fault with is the feeling that these man-made laws are inviolable and the evident disinclination to use that best of gifts, common sense, in their application. All the world knows what Amphioxus is. The name is used in every paper dealing with its structure, but the law of priority demands that Branchiostoma be substituted for it. Were it possible to make the substitution, would there be any more permanence than if the better-known name be left alone? Lepidosteus is in almost world-wide use. Is permanence effected by resurrecting the fact that, in defiance of the laws of euphony and philology, its original form was written Lepisosteus?

But these are not the worst cases to bother us. The most absurd are those changes which are based upon the law that names of similar origin but of different form are in conflict, and that the later one must stand aside on the ground of possible misunderstanding. Ellobius must go because Ellobium was described first; Gymnura must be renamed because of possible confusion with the earlier Gymnurus. These are little better than those cases of changes proposed because of alleged inappropriateness or inaccuracy of name.

We who are not engaged solely in systematic work are beginning to get weary with this continual shuffling and changing of names. We do not find that fixity which we had been led to expect. Names

are less certain in their meaning than they were twenty or thirty years ago. Who can tell to-day what a writer means if he mentions some fact about *Acer saccharinum?* One must first be acquainted with the mental composition of the author; is he radical or is he conservative in his make-up?

We can suggest no better business for the American Association for the Advancement of Science than the appointment of a committee to take the initiative in reopening this whole question of laws of nomenclature, and in the appointment of such a committee care should be taken that morphologists and physiologists as well as systematists should be recognized in its make-up. It would be desirable to see if it be not practicable to institute some law of limitation to the priority rule, or there will always be those who will write Astacus when they refer to the lobster. Such a committee could coöperate with other similar bodies appointed by other scientific organizations elsewhere, and thus make some laws of universal application.

Marvelous Technique. — At various times during the past year the daily papers have contained accounts of a wonderful discovery on the part of an alleged American professor to the effect that he had been able to increase the magnifying power of the microscope to an extent hardly dreamed of by other workers. So long as these accounts were confined to the daily press we took no notice of them, but now that they have obtained entrance into such a worthy journal as the *New York Medical Times* we think it time to lodge a protest. The "discovery" is in effect the insertion of a second microscope in the place of the ocular of the first. It is true that this will result in an amplification of the image, but every tyro knows that this process is an old one, and that, while an enlargement results, there is no gain in definition; it is merely a magnification of the imperfections of the first objective. Still greater amplification than any this so-called professor claims can be obtained by the simple projection microscope, but no one who has seen a nucleus thus "thrown up" until the image has a diameter of six or eight feet will claim that the process discloses features before invisible.

The same brilliant discoverer announces also a still more brilliant discovery in technique by which he has been able to obtain sections "of about one one-hundredth the thickness of the finest slice ever hitherto obtained." For refinement of technique his procedure "beats the Dutch." "I cemented upon a glass slide a single layer of cells, and then placed upon this slide another slide whose surface had been freshly covered with cement and allowed them to remain in

contact until the upper and lower surfaces of the cells had become cemented to the glass slides. Then I introduced between the two glass plates a very thin blade of copper (!), the edge of which had been sharpened to the very finest cutting surface possible. . . . This blade is introduced between the two plates and pushed along between them so as to separate them, and on its way it slices the cells in the middle. One of these plates is then cemented to another glass plate with the cut surfaces of the cells against the other glass plate and the slicing operation repeated," *ad infinitum.*

The same article proceeds next to the superlative. No longer will Spencer's well-known characterization of life be quoted. Our brilliant professor has solved the problem. "I am satisfied," says he, "that life is mind — that all vital phenomena are mental. A cell can feel stimuli and can *adapt acts* to *ends* (*sic*). Now, only mind can do this; only animate bodies have minds, and mind alone it is which constitutes their life." There follows much more of the same sort, but we have no room for further quotations. Some years ago the *American Naturalist* (vol. xxi, p. 549) advertised for an author for a much needed "Unnatural History," stating the qualifications necessary in the person who should undertake the work. The author is now found, and if the present flow of lucubrations be continued, the volume missing from all libraries will soon be an accomplished fact.

The Society for Plant Morphology and Physiology. — In the formation of the Society for Plant Morphology and Physiology an important step has been taken for the advancement of botany in America. We have no intention of assuming the functions of a scientific newspaper, but the first annual meeting of this society is an event of such significance that we are very glad to publish the report of its proceedings, which is presented on another page. At this meeting the workers on the morphological and physiological sides of botany have come together for the first time as a distinct body, and one is able to obtain for the first time a comprehensive view of what is being done in this country along these lines of investigation. There was, naturally, considerable variation in the quality of the papers presented, but one cannot fail to be impressed with the variety and amount of work which they represent and their generally excellent character. Certainly the society is to be congratulated upon the success of its first meeting, and no doubt its meetings in the future will be of even greater interest, and will exert a profound and broadening influence not alone upon the botany in this country but upon the biology in general.

REVIEWS OF RECENT LITERATURE.

GENERAL BIOLOGY.

The Rôle of Water in Growth.[1] — Dr. C. B. Davenport has made an interesting series of experiments upon the eggs and embryos of Amblystoma, toads, and frogs to determine the proportions of water relative to the other constituents of the body during the earlier stages of growth. Defining growth as "increase in volume," he finds that "exactly as in plants, there is a period of slow growth accompanied by abundant cell division — the earliest stages of the egg. There follows, after the first few hours, a period of rapid growth due almost exclusively to imbibed water, during which the percentage of water rises from 56 to 96; lastly comes the period of histological differentiation and deposition of formed substance, during which the amount of dry substance increases enormously, so that the percentage of water falls to 88 and below. But the *growth* is due chiefly to imbibed water."

Assuming for the sake of argument "that the dry substance is all growable," the author finds that the curve of daily percentage increments based on dry weights of tadpoles fails to confirm Minot's generalization that there is a "certain impulse given at the time of impregnation which gradually fades out, so that from the beginning of the new growth there occurs a diminution in the rate of growth." On the contrary, he finds in tadpoles no loss in the rate of growth of the growing substance. He points out further that no such diminution is noticeable in plants.

There are one or two points in which we would take issue with the author. In the first place, the use of the term "plasma," borrowed from the German, in place of "spongioplasm" or "reticulum" seems to us an unfortunate one. The common use of this term is to designate the fluid portion of the blood, and, therefore, when it is used in a description of the living cell-contents it conveys a false impression to English readers. In the second place, it does not seem to us to follow, because growth as a whole is shown to be due to the imbibition of water, that "we have to conclude, therefore, that all local growths are due to local imbibition of water." It is

[1] C. B. Davenport. *Proc. Boston Soc. Nat. Hist.*, vol. xxviii, no. 3, pp. 73–84. June, 1897.

well known that in tadpoles, especially, nearly all the cells are heavily laden with yolk granules until a relatively late period of development. Of this the author takes no account. It is quite conceivable that local growth might take place without any general or local increase in the percentage of water. Until the larva is able to take food the increase in the dry weight of the living material is due to assimilation of yolk, and it may be that local growth during this period is due solely to the solution, transference, and assimilation of this food supply stored within the organism. If it can be shown that there is an increase in the percentage of water in a local growth, such, for example, as a gill-bar, it may well be that it is a purely secondary phenomenon. Then the question, What determines excessive local growths? would not resolve itself into, What determines excessive local imbibition of water? but into, What determines excessive transference and assimilation of yolk material? In supposing that local growth is due primarily to the absorption of water, whether active or passive, we are assuming a simplicity of operation that is hardly warranted by the known complexity of living material.

The paper is well illustrated by tables and plotted curves.

The Capacity for Regulation in the Development of Organisms. — The word "regulation," as employed by Driesch, expresses the capacity of an organism to obliterate in development the effects of any malforming influence to which it has been subjected, so that, despite the mutilation, it develops into the normal form. Driesch's former studies had been chiefly made upon developing eggs; he now (*Arch. f. Entwicklungsmech.* Bd. v, Heft 3, 1897) examines some cases of regeneration.

As is known from the studies of Miss Bickford, regenerating stems of Tubularia do not form new tentacles by a sprouting out at the cut edge, but by a metamorphosis of the old tissue of the stem just below the cut. The old tissue thickens along a number of longitudinally lying areas representing the future tentacles, which soon become fully formed. This phenomenon of differentiation in place is called by Driesch reparation. The first question Driesch asks is: If the repairing stem be split lengthwise so that a double head is formed, will the normal number of tentacles be repaired through regulation on each half head? The result showed that nearly or quite the normal number is so formed.

Again, if the head is cut off and regenerated, and then cut off a second time, will the time elapsing before complete reformation be

less after the second cut than after the first? Experiment showed that it is so; that, whereas it takes five and one-half days on the average for regeneration to occur after the first cut, it is effected under otherwise similar conditions in three days after the second. The repetition of the stimulus quickens the response.

If a piece of the stem of Tubularia be cut at both ends, regeneration will take place at both the oral and the aboral end. If, now, in one case the oral end be sealed with wax so that it cannot grow and the aboral be left free to regenerate, will the time required for the formation of the aboral head differ in the two cases? The result showed that regeneration of the aboral head occurred in all cases inside of seven days after the cut when only one head was forming, whereas it took over twelve days when both heads were arising. Regeneration is slower when the formative stuff goes to two points than when it aggregates at only one.

The tentacles of Tubularia surround the oral end at two levels. After decapitation, consequently, reparation of tentacles occurs at two zones, a distal and a proximal. The question arises: What will happen if after reparation has begun in both zones the distal zone is cut off? Will a head with only one zone of tentacles arise? Here the marvelous phenomenon of regulation was most strikingly shown. The normal number of zones was regained, and, indeed, by either one of four modes, all producing the same end result, — the restoration of the perfect form of the adult. These four modes are: (1) by regeneration — the cut end grew out, and in this regenerated part the distal zone of tentacles arose by reparation; (2) by dissolution — the remaining (proximal) zone of tentacles was dissolved and in its place the normal condition of two zones appeared; (3) by replacement — the distal zone having been removed so as to leave the maximum space beyond the proximal zone, a new series of tentacles sometimes arose in this empty space without disturbing the proximal zone; (4) by division — the arising tentacles of the proximal zone disintegrated in their middle, forming the two zones characteristic of normal development. C. B. D.

Determination of Sex in Plants. — The causation of sex in the hemp plant, studied at various times in the past, forms the subject of a short communication in the *Comptes Rendus* of the French Academy for Nov. 15, 1897, by M. Molliard, who concludes from his experiments that the medium in which the plant grows may affect its sex, and that, in this case, contrary to the currently admitted

theory, the transformation of staminate into pistillate flowers occurs under conditions disadvantageous for the development of the vegetative apparatus. T.

Plankton Studies. — The first article of volume five of the *Bulletin of the Illinois State Laboratory of Natural History*, recently published,[1] contains a bibliography of the methods of conducting plankton studies and a useful description of the oblique haul and pumping methods which have been in successful use for some years at the Biological Station at Havana, Ill., in the collection and separation of the minute animals and plants floating free in the water and incapable of materially changing their position by their own efforts.

Students of this rather new phase of biology will also find an interesting preliminary report on the plankton of some of the lakes of the Alps and Jura[2] in the *Bulletin of the Botanical Laboratory of the University of Geneva* for June, 1897. T.

ZOOLOGY.

Cell Lineage. — In a paper entitled "Considerations on Cell Lineage, Based on a Reëxamination of Some Points on the Development of Annelids and Polyclades,"[3] Prof. E. B. Wilson presented observations regarding the origin and relations of the mesoblast in annelids and polyclades which illustrate the fact of ancestral reminiscence in cell lineage. In some of the annelids (Aricia, Spio, Nereis, and others) the primary mesoblasts have not been properly so called, for before giving rise to the mesoblast bands they bud forth cells that may be, in some cases, traced into the wall of the archenteron. In Nereis not less than six or eight such cells are formed; these become pigmented, wander into the interior, and finally give rise to the posterior part of the archenteron. In Aricia and Spio only a single pair of corresponding cells is formed, and they are so small as to play a quite insignificant part in the building of the body. A comparison of these results with those of Conklin on Crepidula

[1] Kofoid, Plankton Studies, I. Methods and apparatus in use in plankton investigations at the Biological Experiment Station of the University of Illinois.

[2] Pitard, Quelques notes sur la florule pélagique de diverses lacs des Alps et du Jura.

[3] Read before the New York Academy of Sciences, Biological Section, Dec. 13, 1897.

indicates that the mesoblastic pole cells of annelids and mollusks are to be regarded both historically and ontogenetically as derivatives of the archenteron, and that the rudimentary cells of Aricia and Spio are vestiges or ancestral reminiscences of such origin.

A reëxamination of the cell lineage of a polyclade, Leptoplana, shows that, as in the annelid or gasteropod, all of the first three quartets of micromeres give rise to ectoblast, while the second quartet gives rise also to mesoblast, each cell of this quartet segmenting off three ectoblast cells, and then delaminating a large mesoblast cell into the interior. The third quartet apparently gives rise to ectoblast alone, though the possibility of its producing mesoblast is not excluded. The four macromeres remaining give rise to the archenteron, as Lang describes, first dividing to form four basal cells (corresponding in origin and position with the four basal entomeres of annelids and mollusks) and four much larger upper cells which correspond to the fourth quartet of micromeres in annelids and mollusks. The posterior of these cells always divides before the others, sometimes equally and symmetrically, as in Discocoelis (Lang), but more often unequally. The cells thus formed give rise to a part of the archenteron, and not, so far as can be determined, to mesoblast.

These observations show that the mesoblast of polyclades is of ectoblastic origin, and they suggest that the origin of mesenchyme cells from the second (Unio, Crepidula) or third (Physa, Planorbis) quartets in gasteropods may be a vestige or ancestral reminiscence of the mesoblast formation in the polyclades. They suggest, further, that the mesoblast bands (entomesoblast) of annelids and mollusks may have been historically of later origin than the mesenchyme (ectomesoblast) — a view which harmonizes, broadly speaking, with that of Meyer — and that the two symmetrical entoblast cells into which the posterior member of the fourth quartet divides in the polyclade may represent the prototypes of the entomesoblasts of the annelids and gasteropods.

Early Stages in the Development of Molgula. — Mr. Crampton briefly reviewed his observations on the early history of the egg in *Molgula manhattensis* as follows: [1]

The author emphasized the fact that development begins not with the cleavage or fertilization processes, but even before. From the origin of the primary oöcyte until the final assumption of the adult

[1] Paper read before the New York Academy of Sciences, Biological Section, Dec. 13, 1897.

form, there is a continuous series of developmental changes, each stage being based upon the preceding one and conditioned by it.

The growth of the primary oöcyte and the formation of the yolk were considered at some length. A true "yolk nucleus" arises, as the author believes, from the nucleus, and this by continued growth, and later by fragmentation, gives rise to very small spherules, which later, by enlarging, form the yolk spherules. The yolk nucleus is an albuminous body closely allied to, if not identical with, the yolk or deutoplasm. This was indicated by a large number of microchemical tests. The yolk nucleus at a very early stage of the egg was also shown to be the only albuminous body in the cell; for the rest of the extra-nuclear part of the cell is almost exclusively composed of pseudo-nucleinic substances. Evidence was cited which indicated that the yolk nucleus was formed by the nucleus, and that it enlarged by constant additions to it from the nucleus.

The more important results of a study of the maturation and fertilization processes might be briefly stated, although a fuller account will appear in the published paper. The first maturation spindle arises entirely from the germinal vesicle. It is peculiar in that it is barrel shaped, and does not, as far as can be determined, bear at either end centrosomes or asters. The first polar body receives sixteen chromosomes, while sixteen remain in the egg. The second maturation spindle is also barrel shaped, and is also devoid of centrosomes and asters. Eight chromosomes remain in the egg. The sperm entrance was described in detail, and evidence was brought forward to show that the centrosomes of the first cleavage figure were derived from the sperm.

The spindle of the first cleavage figure appears to be formed from the segmentation nucleus, there being no 'central spindle' extending between the centrosomes. The spindle itself was shown to be barrel shaped, the daughter chromosomes reforming into a vesicular nucleus at the ends or heads of the barrel. A "Zwischen-Körper" also arises, as in the maturation stages, by a concentration of the spindle fibers at the equator of the figure. After the reformation of the daughter nuclei, and after division of the cell body, the paired daughter centrosomes and asters diverge. The daughter nucleus later moves up between the asters, and prepares for the next division. Comparative independence and parallelism of the processes undergone by the centrosomes and asters, on the one hand, and those of the nuclei, on the other, become very strongly probable. Detailed evidence in support of the above points will be given in the published paper, a preliminary notice.

Zoology at Johns Hopkins. — The number of the *Johns Hopkins University Circular* for November, 1897, is devoted to accounts of biological work done. In the introduction Prof. W. K. Brooks gives an outline of the work of the Jamaica expedition of 1897. Dr. H. L. Clarke's paper on the *Viviparous Synoptidæ* of the West Indies is reprinted from the *Zoologischer Anzeiger*. Prof. Maynard M. Metcalf discusses the follicle cells in Salpa, in which he supports the earlier results of Brooks. Dr. George Lefevre has a paper on "Budding in Ecteinascidia." In this form the bud development is strikingly like that in Perophora, as described by Ritter, except for the peculiar rotation of the inner vesicle, which complicates the process in that genus. Dr. F. S. Conant describes one new genus (Tripedalia) and two new species of Cubomedusæ (*T. crystophora* and *Charybdea xaymacana*). The paper is more than systematic, for it contains notes upon the anatomy and development. We understand that Dr. Conant's notes and drawings made during the past summer have been preserved and will be included in the full paper, to be published later. Mr. Gilman A. Drew has some interesting notes on the embryology of the primitive mollusk Yoldia. The most important features in the development are the formation of a larval test, only paralleled by that of Dondersia and the formation of the central ganglia from the walls of invaginations. Dr. E. A. Andrews describes some spinning activities of the polar globules in echinoderms, mollusks, and nemertines, phenomena to which attention has but recently been called.

BOTANY.

Botanical Observations on the Azores,[1] by William Trelease. — During the summers of 1894 and 1896 Professor Trelease, Director of the Missouri Botanical Garden, made two excursions to the Azores. By his friends it was generally supposed that these journeys were rather in the nature of well-earned vacation trips of a man whose productive research work and arduous executive duties must call for occasional relaxation. It is accordingly a matter of some surprise to see as a result of these trips a stout, closely printed, and excellently illustrated report, including not only a careful compilation of the work of others, but hundreds of entries of

[1] From the *Eighth Annual Report of the Missouri Botanical Garden*, issued Sept. 9, 1897.

personal observations. Of this report the introductory pages give a concise statement of the geography, geology, and meteorological conditions of the archipelago, followed by a habital description of the vegetation, including not only the gradually disappearing indigenous element and numerous introduced species, but even the varied plants of cultivation.

The body of the report is occupied by a complete enumeration of the plants, both phænogamic and cryptogamic, known to grow naturally upon the islands. In this list, the following classes of plants are distinguished by different kinds of type: (1) endemic species, (2) Atlantic species of wider distribution, (3) established escapes, (4) doubtful or casual plants. Even the relative abundance of the different species is indicated by signs, so that their respective importance in making up the entire vegetation can be readily inferred. After the names of each species and variety are enumerated the islands on which it occurs, various authenticated *exsiccati*, and several references to the most accessible descriptions and figures. The nomenclature of the Kew Index has been followed "as a matter of convenience." — Would that some other American botanists could be content to follow this example and at the same time consult both their own convenience and that of their colleagues! — Some half-dozen new species and varieties of phænogams are characterized, and these, as well as a number of other rare and hitherto unillustrated endemic species, are admirably figured in fifty-four plates, drawn by Miss Grace E. Johnson.

Professor Trelease has sought in vain for evidence of that racial and varietal divergence in the florulæ of the different islands which is so pronounced in the Galapagos Archipelago. This fact, however, is not very surprising. Such a divergence could scarcely come about unless the florulæ were to a considerable extent isolated; for, if this were not the case, there would be constant crossing and reblending of nearly related forms. In the matter of isolation of the different islands, the Azores and the Galapagos Archipelago are in no sense similar. As Wallace has pointed out, the meteorological conditions for seed distribution are much more favorable in the Atlantic than in the Pacific. But a still more important difference lies in the long habitation of the Azores and constant human intercourse between the different islands of the group. This cannot have failed to bring together plants which have tended toward racial divergence, and these when established upon the same island have most likely crossed freely and again formed a common stock.

The carices of the list, so far as represented by the collections of Professor Trelease, have been identified by Prof. L. H. Bailey, and the cellular cryptogams by a number of specialists. At the close of the paper is a generic index and a bibliography of Azorean botany. The whole report is not only a great credit to its author, but forms the most noteworthy piece of recent American work upon any extra-American flora. B. L. R.

The Flora of British India. — With the publication of the title-page and preface of the seventh volume, and a full index (collated with the *Index Kewensis*) to the entire work, *The Flora of British India*[1] is brought to a close at the end of 1897. In the quarter of a century consumed in its publication the area to which it is devoted has materially increased, and many new collections have been brought to the hands of its indefatigable editor and his collaborators, so that it is but natural that the later volumes should be more thorough than the earlier ones. Valuable it is, throughout; and yet, as Dr. Hooker remarks in the preface to the concluding volume, the treatise is to be regarded as a pioneer work rather than a finished flora. There is no reason to doubt, however, that time will justify his very modestly expressed hope that it may not only enable botanists to name with some accuracy a host of Indian plants, but that it may further facilitate the compilation of local floras and monographs and the discussion of the problems of the distribution of plants from the point of view of what he very well characterizes as perhaps the richest and certainly the most varied botanical area on the surface of the globe, and one which, in a greater degree than any other, contains representatives of the floras of both the Eastern and Western Hemispheres. T.

Miss Eastwood's Studies.[2] — In the second part of the recently inaugurated botanical section of the *Proceedings of the California Academy of Sciences*, Miss Eastwood gives interesting information concerning a number of plants from the White Sands of New Mexico; a comparative study of spurless forms of Aquilegia, in

[1] *The Flora of British India.* By Sir J. D. Hooker, assisted by various botanists. London. L. Reeve & Co. Pts. xxiii and xxiv. Price 18s. net. — The dates of publication of the volumes, as follows: i, May 1872–Feb. 1875; ii, May 1876–May 1879; iii, May 1880–Dec. 1882; iv, June 1883–Aug. 1885; v, Aug. 1886–Apr. 1890; vi, Dec. 1890–Apr. 1894; vii, 1896–1897.

[2] Alice Eastwood, Studies in the Herbarium and the Field. No. 1. *Proc. Calif. Acad. Sci.* 3 ser. Botany, i, No. 2, 71–86. Pl. VI, VII.

which several nominal varieties of this character are described; descriptions of new Californian species belonging to the genera Iris, Montia, and Newberrya; and a revision of the Manzanitas of Mt. Tamalpais, in which, because of the inadequacy of printed descriptions and other difficulties, three forms that seem undescribed are described and named as distinct species, while it is left to some future monographer of the genus to assign "definite limits, if that be possible in so polymorphous a genus, which continually suggests hybridization or a very active and unlimited tendency to vary."

T.

Pittonia. — In the seventeenth part of volume three of this work,[1] which appears at irregular intervals, Professor Greene writes on new species of Eriogonum; the hop trefoils, for which he takes up Desvaux's name Chrysaspis; a second list of corrections in nomenclature, in which he takes up Necker's name Aragallus for a large number of leguminous plants usually known as Oxytropis or Spiesia; a nineteenth instalment of "New or Noteworthy Species," dealing likewise largely with Leguminosæ; on the classification of asclepiads, in which the genus Oxypteryx is proposed for *Asclepias arenicola* Nash, and Podostemma for certain other species clustering about *Asclepias longicornu* Benth.; the genus Chamæcrista, first established by Commelin in 1697, and of which, fortunately, considering their recent multiplication, no species are characterized as new, though nine are transferred from their familiar association with Cassia; a sixth part of "Studies in the Compositæ" devoted to a discussion of the following new and restored genera: Leucosyris, Leucelene, and Ionactis, the latter based on *Aster linariifolius* L., *Chrysopsis alpina* Nutt., and *A. stenomeres* Gray; a twentieth instalment of "New or Noteworthy Species," well distributed over the Polypetalæ and Gamopetalæ; a second series of "Studies in the Cruciferæ," in which the genus Nesodraba is proposed for several species of the Alaskan region, previously referred to Draba or Cochlearia; and "Notes on Violets," accompanied by three plates illustrating *Viola emarginata.* T.

Cell or Corpuscle? — Under this title, in *Natural Science* for December, 1897, Rudolf Beer discusses the much-vexed question of the terminology of those structural units which are yet organisms rather than the ultimate units of organs. Concluding that in vege-

[1] *Pittonia.* A series of botanical papers by Edward L. Greene. Washington, September–December, 1897. Price, 50 cts.

table anatomy either the wall or the living contents of the so-called cell must be renamed, he would retain the name cell for the former, designating the cytoplasm and nucleus as a corpuscle, believing that in this way botanical and zoological terminology may be brought into harmony most readily.

The Septate Leaves of Dicotyledonous Plants. — M. John Briquet, in the *Bulletin of the Botanical Laboratory of the University of Geneva*, for June, 1897, gives an interesting summary of his recent studies on certain of the plants possessing the foliar septa first recorded by Guettard in 1747, and for many monocotyledous genera and the single dicotyledonous genus Villarsa, examined in detail by Duval-Jouve in 1873. To these M. Briquet now adds species of the umbelliferous genera Ottoa, Crantzia, and Tiedemannia. With Duval-Jouve, he concludes that the diaphragms or septa serve to increase considerably the solidity of construction of the leaf without interfering with the free circulation of gases in its intercellular spaces. While the majority of plants possessing these structures are aquatic or subaquatic, *Tiedemannia teretifolia* is shown to be amphibious and to possess admirable adaptations to existence during alternating periods of extreme wet and drought. T.

The Photosynthetic Organs of Asparageæ. — Though, as is too frequently the case with students of vegetable anatomy, Professor Reinke has no thought of a monograph of this interesting group, his recent study of the cladodia of Asparagus, Ruscus, Danæ, and Semele [1] contains much that is of interest to the systematist, and justifies the conclusion that these aberrant genera are really derivatives of the leafy Siliaceæ. T.

New Hardy Nymphæas. — In the *Revue Horticole*, of Paris, for Nov. 16, 1897, M. André describes three new hardy Nymphæas of the odorata type, — *N. gloriosa*, *N. Ellisiana*, and *N. odorata exquisita*, — which have recently originated as seedlings under the hands of M. Latour-Marliac, whose beautiful seedlings and hybrids of American pond lilies are now known wherever this attractive class of aquatics is cultivated. T.

Flora of Africa. — To the many recent publications on the African flora is now added a list in which the botanists of the Brussels Garden propose to publish rapidly the new species and interesting facts brought out in the examination of the collections they are now

[1] Reinke, Die Assimilationsorgane der Asparageen. Eine kritische Studie zur Entwickelungslehre. *Jahrbücher f. wiss. Bot.*, Bd. xxxi, Heft 2, 207–272, f. 26.

receiving. The first fascicle,[1] just issued, adds one hundred and fifteen species to the known flora of the Congo, and describes twenty as new to science. T.

Proprietary Rights in Science. — Another incident in the history of the Rouy and Foucaud *Flore de France*, given to the curious reader by M. Malinvaud in the *Journal de Botanique* of October 19, opens a question of general ethics in scientific citation. It appears that in the flora named a Dentaria is ascribed to a certain region on the authority of two persons, one of whom is one of the authors of the book, while it is now shown that some eighteen years ago the plant was found and first recorded for that locality by others. The author in question claims that his custom has been to cite specimens seen by himself in the course of his study. His critic evidently contends for the citation of the original discoverer. The practice of the more thorough American botanists would lead one to believe that possibly either party in the present instance is little more than half right, with the balance slightly in favor of the author who has actually seen the specimen on which an entry is made. T.

The November number of the *Johns Hopkins University Circulars* contains, in abstract, a paper by D. S. Johnson, on the leaf and sporocarp of Marsilia.

A sad chapter in the history of American biology is supplied by Professor Brooks's notes on the Johns Hopkins expedition to Jamaica in the summer of 1897, in the *Johns Hopkins University Circular* for November, and the memorial minutes, in the same number, accompanied by biographical sketches of James Ellis Humphrey and Franklin Story Conant. These promising biologists, the former already well known in botanical circles, and the latter coming to the front in zoology, fell victims to the ever-present fever of the tropics, and it may well be asked if their death should not suggest more care than has usually been given in the organization of expeditions for scientific exploration where such diseases are likely to occur.

Students of human nature who have observed the punctiliousness with which the *Monsieur de's* in the reign of terror inscribed themselves as *Citoyens* will find some entertainment and no small food for reflection in an article by Dr. Alfred Chabert on the well-known botanist Villars, published in number ten of the *Bulletin of the Boissier Herbarium* for 1897.

[1] Durand and de Wildeman, Matériaux pour la flore du Congo. Premier fascicule. *Bull. Soc. Roy. de Bot. de Belgique*, tome xxxvi, pp. 47–97, pl. III–VI.

PALEONTOLOGY.

Harris's Catalogue of Australasian Tertiary Mollusca.[1] — The catalogues published by the trustees of the British Museum generally contain much more than their titles imply. In them will often be found some of the latest applications of the laws of evolution and the elucidation of new and important principles of morphology. Discussions of this nature have added value and weight from the intimate association of specimens and ideas, for usually curators of collections and custodians of ideas are too frequently dissociated. It is, therefore, a wise policy to engage the services of the highest talent in the preparation of the catalogues or reports on various collections or classes of organisms.

Thirteen volumes on fossil vertebrates, eight on fossil invertebrates, and three on fossil plants have already been published in this series, and Dr. Woodward states that thirty volumes more will be needed to include the remainder of the plants and Mollusca, the whole of the Brachiopoda, Annelida, Arthropoda, Echinodermata, and Cœlenterata.

The present catalogue of the Tertiary Mollusca of Australasia is based upon the study of large collections, especially rich in well-preserved Gastropoda. Mr. Harris has thus been enabled to study the larval shells and the stages of growth with accuracy and precision. In studies of phylogenies and in the systematic classification of the Gastropoda the results are important. The scaphopods and lamellibranchs are also included, but owing to meager material they have afforded insufficient data for general conclusions.

Some valuable suggestions are given governing the correlations of phylogeny with chronology. Thus, a genus that has survived from early Mesozoic times, with but little modification in the later stages of its history, has had its day and settled down to a more or less fixed form. Such a genus is of little use for homotaxial purposes, though interesting phylogenetically. In the Tertiary the determination of homotaxis can best be based upon families which originated in Jurassic or Cretaceous times and reached the Eocene with strong tendencies to variation ; yet, at the same time, the members should be capable of wide and rapid dispersion.

[1] Catalogue of the Tertiary Mollusca in the Department of Geology, British Museum (Nat. Hist.). Pt. i. The Australasian Tertiary Mollusca. By George F. Harris, F.G.S. 8vo, pp. i–xxvi, 1–407. Pl. I–VIII. London. Printed for the trustees. 1897.

The general law is suggested that when the main features of ornament are foreshadowed in the early nepionic or brephic stage, and especially when they obtain even in the protoconch, that ornament may be regarded as of value in the determination of species. On the contrary, when the ornament does not make its appearance until the late neanic or adolescent stage, and, even in an elementary sense, is not completed until what may be regarded, by analogy, as the early mature stage, that ornament merely characterizes the individual, and is only of negative use for the purposes of classification.

As is well known, the size of the protoconch is variable, even in the offspring of a single individual, that difference being commonly attributed to carnivorous proclivities on the part of the larger specimens when in the embryonic stage. The author also notes that the size of the protoconch does not seem to have much influence in determining the size of the shell in the adult. The larger protoconch is not very often accompanied by the production of a larger adult shell than that which comes from a much smaller protoconch, that is, in the same species. There are, however, exceptions to this, and, correlatively, it may be noted that the shape of the protoconch occasionally determines the general shape of the shell.

Further interesting observations are made on the development of the Volutidæ, the columellar plications in Mitra, and the recurrence of a type of ornamentation in a species of Cerithium. All the genera are briefly described, and the type species is given. The notes on the species are preceded by a list of the synonymy and bibliographic references.

Some changes in the nomenclature of the genera will not meet with general endorsement, although the principles adopted are, for the most part, those approved by the best authorities. Thus, the name Nuculana (Link, 1807) is used instead of Leda (Schum., 1817) on the ground of priority. Nuculana, however, was given by Link as a mere verbal substitute for Nucula (Lam., 1799), as Dr. W. H. Dall and others have shown. Link's diagnosis applies to Nucula and not to Leda, for he says that the shell is "smooth, closed all round." Nuculana (Link *non* Adams) is therefore "an exact synonym" of Nucula, and cannot be sustained on the ground of priority. Consequently the family name Nuculanidæ, Adams, cannot be retained for Ledidæ.

C. E. B.

PETROGRAPHY.

California Eruptive Rocks. — The "bed-rock" series of the Sierra Nevadas underlying the sands, gravels, and volcanic rocks in the vicinity of Nevada City and Grass Valley, Cal., consists of highly altered sedimentary rocks, crystalline schists, and igneous rocks, much resembling pre-Cambrian complexes elsewhere, but which here are known to be much younger than Cambrian.

Lindgren[1] describes the old igneous rocks as comprising granodiorite, a type of rock intermediate between granite and quartz, — mica-diorite, aplite, granite-porphyry, diorite-porphyrite, diorite, gabbro, serpentine, diabase, porphyrite, augite-syenite, and amphibolite. The limits of variation of the granodiorite are shown by the following figures :

SiO_2	Al_2O_3	Fe_2O_3	FeO	CaO	MgO	K_2O	Na_2O
59–68.5	14–17	1.5–2.25	1.5–4.5	3–6.5	1–2.5	1–3.5	2.5–4.5

Its predominant feldspar is a plagioclase, though orthoclase is present in small quantities, often intergrown with albite forming micro-perthite.

The gabbros are distinguished from the diorites by the character of their feldspathic component. This is a mediumly acid variety in the diorites and a basic variety in the gabbro. The ferromagnesian constituent in the latter rock may be either pyroxene, hornblende, or mica; though, as a matter of fact, all the gabbros described by the author contain some form of pyroxene or its alteration product. The serpentine is derived from pyroxenite and peridotite.

The diabases and porphyrites probably represent the cores of old volcanoes. These rocks grade into each other through so many different types that the author finds it difficult to classify them. The principal distinction made use of in defining them appears to be coarseness of grain, "since the diabase may readily become porphyritic, the resulting rock being referred to as diabase-porphyrite. A more pronounced porphyritic structure with finer-grained holocrystalline groundmass gradually leads over into the porphyrites, referred to as augite-porphyrites or hornblende-porphyrites." A majority of the porphyrites might be classed as apo-andesites, though the rocks are very different from the andesites of the district.

[1] *Seventeenth Annual Report of the U. S. Geol. Survey*, vol. ii, p. 2. Washington, 1896.

The amphibolites are "massive or schistose rocks composed chiefly of hornblende, usually with smaller quantities of quartz, feldspar, epidote, and chlorite." They are in most cases dynamically metamorphosed diabases or porphyrites.

The sedimentary rocks of the district are siliceous argillites, clay-slates, quartzites, and micaceous schists. These are altered by both dynamic and contact metamorphism.

The metamorphic processes, excluding weathering, are divided into: (1) dynamic metamorphism, including dynamo-chemical metamorphism, as in the case of the formation of amphibolites from diabases; (2) common hydro-metamorphism produced at low temperatures; (3) hydro-thermal metamorphism, including solfataric metamorphism, and (4) contact metamorphism. The most important characteristic of dynamo-chemically metamorphosed rocks is the production of mosaics. Feldspars are among the most important of the new minerals formed by this process. In hydro-metamorphism the original constituents of rocks are broken down into aggregates with the production mainly of hydrated minerals.

In his discussion of the gold-quartz veins the author calls attention to the fact that the wall rocks of the veins have been much altered by metasomatic processes. The changes effected in them consist mainly in the introduction of carbon dioxide, sulphur, and potassium and the abstraction of silica and sodium. The changes produced in a granodiorite by these processes have resulted in a new rock composed of: sericite = 61.11%, quartz = 25.00%, sphene = .60%, apatite = .46%, pyrite = 2.87%, $FeCO_3$ = .58%, $MgCO_3$ = 2.70%, and $CaCO_3$ = 7.23%. A siliceous argillite, originally consisting of a fine-grained aggregate of quartz, feldspar, brown mica, pyrrhotite, and organic matter, has been changed to an aggregate of sericite, calcite, and residuary quartz. The principal results of the interaction of the wall rock of the veins and the liquids emanating from the vein fissures are thus seen to be carbonates and sericite.

The Rocks of Castle Mountain, Mont. — The Castle Mountain mass in Central Montana is an eroded volcano, which presents "all the different types of crystallization and structure possible for an igneous magma to assume under the most varied conditions of cooling and pressure." In general, the rocks have been derived from a siliceous magma rich in alumina and the alkalies. This has given rise to the various members of the granite-rhyolite family in the district. Associated with these, but in much smaller amounts, are

found augite-diorite, porphyrites, lamprophyres, and basalts. These are arranged as follows: plutonic rocks in the central core, porphyritic rocks in intruded sheets and dikes, extrusive rocks in lava flows, and tuffs and breccias underlying the lavas. All these different rocks are described in detail by Weed and Pirsson.[1] The plutonic rocks are granite and augite-diorite. They have altered the shales through which they intrude into tough hornstones, and the limestones into coarsely crystalline marbles containing in places garnet, phlogopite, vesuvianite and pyroxene.

The naming of the rock types discussed by the authors is based on their macroscopic texture. In the acid series, for instance, those rocks are called granite which appear holo-crystalline to the naked eye. Those are named quartz-porphyry which possess a groundmass so finely granular that its components cannot be distinguished without the aid of a microscope, and those that contain glass or a very dense groundmass are called rhyolite. In their description of the granite-porphyry the authors describe the micro-pegmatitic structure as an original one and express doubts as to its ever being secondary. Dark basic concretions in the granite are regarded as the result of the liquation of the liquid magma from which the rock solidified. One of the most interesting of the quartz-porphyries described is a rock containing sufficient tourmaline to rank as an accessory component. This mineral occurs in stellate groups replacing feldspar. Very frequently fluorite is associated with it. An analysis of this rock gave:

SiO_2	TiO_2	Al_2O_3	Fe_2O_3	FeO	MnO	MgO	CaO	K_2O	Na_2O	Li_2O	KH_2O	Total
74.82	.25	13.80	.37	.30	tr.	10.	.17	4.81	4.33	tr.	.83	= 99.78

The lamprophyres cutting the "belt series" of shales, etc., are augite, — vogesites, minettes, monchiquites, and diabases. Many of the rhyolites are devitrified and many of them contain spherulites. These are thought in all cases to be original.

A comparison of the analyses of the different rock types of this district shows that no absolute relation exists between the silica and the different bases; but it seems to indicate that there is a definite relation between the quantities of soda and potash present. The differentiation of the Castle Mountain series appears to have been deep-seated.

The igneous rocks of the Denver Basin, Colorado, are principally basalts, which appear on the plains at the foot of the mountains as dykes and surface flows or sheets. Augite-syenite and quartz-

[1] *Bulletin 139 of the U. S. Geol. Survey.* Washington, 1896.

porphyry also occur in the district, but in small quantity only. All the basalts contain orthoclase in fairly large quantity. An analysis of the rock from a dyke at Valmont gives:

SiO_2	TiO_2	Al_2O_3	Fe_2O_3	FeO	CaO	BaO	MgO	K_2O	Na_2O	P_2O_5	Cl	SO_3	H_2O	Total
48.25	.89	16.73	3.99	6.28	8.32	.013	5.77	4.08	3.24	.68	.08	.12	1.72	=100.163

The augite-syenite is a biotitic variety containing some bronzite.

The tuffs occurring in the district are andesitic. These and certain andesitic pebbles found in conglomerates are the only evidences met with in the study of the district that point to the former presence of andesite lavas in the vicinity.[1]

W. S. B.

[1] W. Cross, Ch. V. Geology of the Denver Basin in Colorado. Monograph XXVII. *U. S. Geol. Survey*, p. 315.

SCIENTIFIC NEWS.

Syracuse University will begin the erection of a $45,000 Science Building in the spring. Adelbert College, at Cleveland, Ohio, has a Biological Building under way which will cost about the same amount, while Richmond (Va.) College has received $5000 towards a Science Building.

Lafayette College met a severe loss by the burning of Pardee Hall December 18. The fire caught in the biological laboratory and destroyed a large part of the scientific equipment. The most valuable part of the herbarium was saved.

Sir W. C. McDonald has recently given $200,000 to the scientific departments of McGill University.

At the middle of December $65,000 had been subscribed for the proposed zoological gardens at Bronx Park, New York.

The *American Geologist* is to do a much-needed work in its proposed catalogue of current papers relating to the geology of North America.

Dr. Justus Gaule, professor of physiology in Zürich, has resigned.

Dr. Nikolaus Michael Melnikow has resigned the professorship of zoology in the University of Kazan.

Dr. Ludwig Karpelles, of Vienna, the well-known student of the Acarina, has changed his surname to Karell.

For several years the University of Tokyo has maintained a biological station at Mazaki, an exposed point about half a day's sail from Tokyo. While the collecting near here is very fine, the place has many drawbacks, and so it has been decided to remove the station several miles further north. The former building will be moved, and be incorporated in the new structure, which will be larger than the old one.

The University of Upsala receives about $45,000 for the establishment of an associate professorship of physiological botany, the donor, Franz Kempe, stipulating that Dr. Lundström be the first appointee.

Dr. R. Semon, whose work upon the fauna of Australia is so well known, has resigned his position as docent in zoology in the Uni-

versity of Jena. It is doubtful if the large work on Australia already begun is ever completed. Indeed, the monotremes and Ceratodus seem veritable "hoodoos." The material obtained a dozen years ago by Mr. Caldwell, aided by Royal Society funds, is lying unused, and with no prospect of being studied.

Will some reader of this journal inform a correspondent concerning "Teichmann's injection mass"? It is mentioned by Hochstetter (*Morphologisches Jahrbuch*, vol. xiv, p. 122) as being admirably adapted for use with the fish-like forms.

The British government is gradually grinding out "Jubilee medals." Among the latest to receive them are Dr. Albert Günther, the well-known ichthyologist, and Dr. R. Meldola.

The Zoological Society of South Australia receives $10,000 by the will of the late Sir Thomas Elder, and the Medical School of the University of South Australia receives $100,000 from the same source.

The Harvard Natural History Society celebrated its fiftieth anniversary December 17 with addresses by Prof. N. S. Shaler and William T. Hornaday. It is next to the oldest student scientific society in America, the oldest being the Lyceum of Natural History at Williams College, which was founded in 1837 and has retained a vigorous organization since that time.

Gen. Albert Ordway, who died in New York City November 21, was at one time a student under Agassiz, and published one or two papers upon the Crustacea, the most notable being an outline of a monograph of the species of the genus Callinectes (better Neptunus). He was born in 1843, entered the army, and was connected with military organizations during the remainder of his life.

With the new year Prof. Raphael Blanchard begins the publication of a new magazine, *Archives de Parasitologie.*

The library of the late Prof. Carl Vogt goes to the Senckenberg Natural History Society at Frankfurt-on-the-Main.

Hamilton College (Clinton, N.Y.) has just dedicated a new science building given by Mr. Elihu Root, and named in honor of his father.

The Royal Society has awarded the Copley medal to Prof. Albert von Kölliker, of Würzburg, who just before had received the Retzius medal from the Swedish Medical Association.

Sir William Flower has resigned the presidency of the International Zoological Congress. Sir John Lubbock has accepted the office, and will preside at the meeting at Cambridge next August.

In a recent number of this journal we gave an outline of several expeditions of the summer of 1897. In addition to those there noted must be added the botanical expedition of Mr. J. M. Rose to Mexico. Lower California, the west coast of Mexico, and the states of Zacaticas, Durango, and Jalisco were explored, and the collections brought back contained 2000 numbers. Mr. A. P. Morse, who is connected with Wellesley College, visited the Pacific coast under the direction of Mr. S. H. Scudder, and made large collections of insects and especially of Orthoptera.

At the meeting of the Academy of Science of St. Louis, on the evening of January 3, the following officers for 1898 were installed: President, Edmund A. Engler; Vice-Presidents, Robert Moore and D. S. H. Smith; Recording Secretary, William Trelease; Corresponding Secretary, Joseph Grindon; Treasurer, Enno Sander; Librarian, Gustav Hambach; Curators, Gustav Hambach, Julius Hurter; Directors, M. H. Post, Anand Ravold.

Prof. R. A. Philippi has resigned the directorship of the National Museum at Santiago, Chili, on account of his age (90 years). He has held the position for 43 years. He is succeeded by his son.

The Department of Agriculture has decided to abandon the subtropical laboratory maintained for several years past at Eustis, Florida. We are not in a position to judge of the economic results of the laboratory, but its scientific production has been such as to make its abandonment a matter of regret.

Dr. Harrison Allen died in Philadelphia November 14. He was born in that city April 17, 1841, studied medicine in the University of Pennsylvania, served as assistant surgeon in the United States Army during the Civil War, and in 1865 was appointed professor of comparative anatomy in his *Alma Mater*, a position which in 1878 was changed to the professorship of physiology. Dr. Allen was a careful and accurate anatomist, and his papers on the anatomy of mammals and the systematic descriptions of the Chiroptera are of great value. Personally, Dr. Allen was a delightful companion, and his death, with that of Drs. Horn and Cope, is a severe loss to science, not only in Philadelphia, but in America as well.

Vesuvius is active again, throwing forth ashes and lava from the central crater, and much more from the lower crater called Atrio del Cavallo.

The Northumberland Sea Fisheries Committee and the Durham College of Science have opened a marine biological laboratory at Cullercoats, near Newcastle. Mr. Meek has been placed in charge of the scientific work.

The Berlin Academy of Sciences has granted 3000 marks to Prof. B. Hagen, of Frankfurt, for the publication of an anthropological atlas, 1500 marks to Professor Kohen, of Griefswald, for mineralogical researches, and 800 marks to Prof. R. Bonnet for anatomical studies.

The *Johns Hopkins University Circular* for November, 1897, contains sketches of the late Prof. James Ellis Humphrey and Dr. Franklin Story Conant.

The Annual Report of the Australian Museum at Sydney contains the statement that the Museum has recently acquired the remains of the elephant "Jumbo." Be it known to our antipodal friends that the great and only Jumbo — the Jumbo of the London "Zoo" — is preserved in the United States, his skeleton in the American Museum in New York City, his skin in the Barnum Museum of Tufts College. The Australian Jumbo is but a pretender.

In his admirable address as president of the British Malacological Society, Prof. G. B. Howes has the following extremely pertinent remarks: "One regrettable feature of the year's work has been the tendency toward reversion to the trinomial system and the too rigid adherence to rules of priority. When, in an age in which science is popular, Aplysia becomes Tethys and *vice versa*, and, in one of overcrowding of literature, it is thought desirable to discriminate between 'types,' 'paratypes,' and other sort of types, it were no wonder did the wayside naturalist turn from us in despair. For the purists Ichthyosaurus ought to go, Troglodytes becomes Anthropopithecus. Convenience and fitness of things must be considered. The effects of extreme specialization are here but too evident; one man describing as the result of a life's labor 'characters' which it requires the experience of a life to appreciate. If this course is to continue, let us boldly replace *Homo sapiens* by *Mendax simplex* and have done with it."

Recent appointments: Dr. Gustav von Arthaber, docent in paleontology in the University of Vienna.—W. L. Bray, professor of botany in the University of Texas.—Edgar R. Cummings, instructor in geology in the University of Indiana.—Dr. Eugen Czaplewski, director of the bacteriological laboratory in Cologne.—Dr. O. V. Darbishire, docent in botany in the University of Kiel.—W. L. H. Duckworth, lecturer upon anthropology in the University of Cambridge.—Dr. H. Eggeling, assistant in anatomy in the University of Würzburg.—Dr. S. Fuchs, extraordinary professor of physiology in the University of Jena.—Dr. Otto Fuhrmann, of Geneva, extraordinary professor of zoology at the Academy of Neuchatel.—Dr. Thaddaeus von Garbowski, docent in zoology in the University of Vienna.—Dr. Geo. T. Kemp, professor of physiology in the University of Illinois, Urbana, Ill.—Prof. Gregor Kraus, professor of botany in the University of Würzburg.—Dr. Kreidl, docent in physiology in the University of Vienna.—Dr. Lehmann-Nitsche, chief of the section of anthropology in the Museum of La Plata.—J. G. Luehman, government botanist at Victoria, Australia.—Dr. Alexis Alexander Ostroumoff, professor of zoology in the University of Kazan, as successor of Professor Melnikow.—Dr. Gustav Piotrowski, docent in physiology in the University of Lemburg, Austria.—Dr. Ludwig Plate, titular professor of zoology in the Veterinary School at Berlin.—Dr. Hans Rahl, docent in histology in the University of Vienna.—Herbert M. Richards, instructor in botany in Columbia University.—Dr. Guido Schneider, director of the biological station at Sebastopol.—Dr. William G. Smith, lecturer in botany in Yorkshire College, Leeds, England.—Dr. Julia Snow, instructor in botany in the University of Michigan.—Dr. A. A. Tylor, instructor in biology in Union College.—Dr. Franz Wagner, professor extraordinary of zoology in the University of Giessen.

Louis V. Pirsson, of New Haven, has been appointed professor of physical geology in the Sheffield Scientific School of Yale University, *not* at Harvard, as we stated erroneously in our January number.

Recent deaths: Samuel Allport, petrologist, in Birmingham, England, July 7, aged 81.—Leopold Auerbach, professor of physiology in the University of Breslau, September 30, aged 69.—James Bateman, botanist and author of monographs upon Odontoglossum and upon the orchids of Mexico and Guatemala, at Worthington, England, November 27, aged 86.—Peter Bellinger Brodie, well known for his work on fossil insects, at Rowington, England, November 1, aged

81. — Dr. Louis Calori, formerly professor of anatomy in the University of Bologna. — Dr. Cesare Crety, professor of zoology and comparative anatomy in the University of Sassari, Sardinia, September 14. — Joseph William Dunning, entomologist, in London, October 15. — Prof. Raphael von Erlanger, zoologist, at Heidelberg, aged 33. — Dr. J. Frenzel, zoologist, in charge of the Müggelsee Biological Station near Berlin, aged 39. Dr. Frenzel spent several years in South America, and did much work upon the invertebrate fauna. — Ernest Giles, an Australian explorer. — Francisque Guillebeau, a student of Coleoptera, at Le Plantay, France, August 17, aged 76. — Dr. M. Forster Heddle, mineralogist, St. Andrews, Scotland, November 19, aged 69. — Dr. Samuel Houghton, for thirty years professor of geology in Trinity College, Dublin, October 31, aged 76. — Dr. Nikolaus Kleinenberg, professor of comparative anatomy in the University of Palermo, well known for his researches on Hydra and on the development of annelids. — Prof. Alessandro Lanzillotti-Buonsanti, a student of the anatomy of domestic animals, at Milan, September 10, aged 40. — August Merkel, student of Coleoptera, in Brooklyn, August 19, aged 60. — Samuel A. Miller, well known for his work upon paleozoic invertebrates, at Cincinnati, December 19, aged 61. — Dr. Wilhelm Mörike, docent in geology in the University of Freiburg, and known from his studies of the geology of South America. — Alberto Perugia, ichthyologist, in Genoa, September 24, aged 54. — Johann Schaschl, coleopterist, at Unterburg, Austria, September 26. — Dr. A. Schrauf, professor of mineralogy in the University of Vienna, aged 60. — Dr. Friedrich Wilhelm Snyder, botanist, at Braunsberg, Prussia, aged 87. — Rev. Gustav Standfuss, student of Lepidoptera (father of Max Standfuss), October 6, aged 82. — Dr. Otto Volger, mineralogist and geologist, in Sulsbach, October 18, aged 75. — Capt. E. Y. Watson, student of Lepidoptera, in India.

BOOKS RECEIVED.

ANDREWS, GWENDOLEN FOULKE. — The Living Substance as such: and as Organism. Boston, Ginn, 1897.

ACLOQUE, A. — Faune de France. Paris, Baillière, 1897.

BAILEY, L. H. — Principles of Fruit Growing. New York, Macmillan (Rural Science Series), 1897. $1.25.

BRITISH MUSEUM (Natural History). — Catalogue of Tertiary Mollusca, Part I, Australasia. London, 1897.

EIMER, THEODORE. — On Orthogenesis and the Impotence of Natural Selection in Species-Formation. Chicago, Open Court Pub. Co., 1898. 25 cents.

GEIKIE, SIR ARCHIBALD. — The Founders of Geology. London and New York, Macmillan, 1897. $2.00.

GOODE, GEORGE BROWN. — The Smithsonian Institution. 1846–1896. The history of the first half-century. Washington, 1897.

KINGSLEY, J. S. — Elements of Comparative Zoology. New York, Holt, 1897. $1.20.

INGERSOLL, ERNEST. — Wild Neighbors, Outdoor Studies in the United States. New York, Macmillan, 1897. $1.50.

IOWA GEOLOGICAL SURVEY. — Annual Report, 1896, with accompanying papers. Des Moines, 1897.

MACH, ERNST. — Popular Scientific Lectures. Trans. by J. T. McCormack. 2d edition. Chicago, Open Court Pub. Co., 1897.

MORLEY, MARGARET WARNER. — A Few Familiar Flowers. Boston, Ginn, 1897. 70 cents.

MORLEY, MARGARET W. — Flowers and Their Friends. Boston, Ginn, 1897. 60 cents.

MISSOURI BOTANICAL GARDEN. — Eighth Annual Report. St. Louis, 1897.

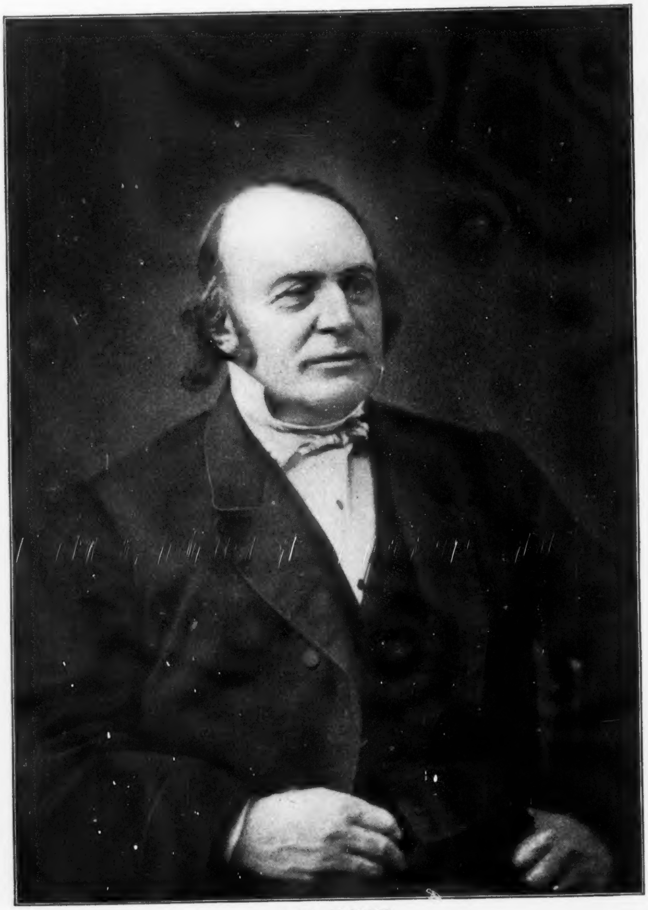
RANDOLPH, HARRIET. — Laboratory Directions in General Biology. New York, Holt, 1897. 80 cents.

ROBINSON, LOUIS. — Wild Traits in Tame Animals, being some familiar studies in evolution. Edinburgh, Blackwood, 1897.

ROMANES, GEORGE JOHN. Darwin and after Darwin III, Post-Darwinian Questions, Isolation and Physiological Selection. Chicago, Open Court Pub. Co., 1897. $1.00.

ROTH WALTER E. Ethnological Studies among the North-west-central Queensland Aborigines. Brisbane, Government, 1897.

TROUESSART, E. L. Catalogus mammalium tam veventium quam fossilium. Nova edite. Fasc. III, Rodentia II. Berlin, Friedländer, 1897. 10 marks.



LOUIS AGASSIZ.

From a photograph kindly lent by Professor Burt G. Wilder.